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CHEMICAL & METALLURGICAL ENGINEERING

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CHEMICAL & METALLURGICAL ENGINEERING

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A Creed and a Goal

PERIODICALLY it is well for institutions as well as individuals to have an hour of quiet introspection, to take stock of past performance, to measure actual achievement against earlier hopes and expectations, to chart the future course and lay out a plan of work. *Chem. & Met.* has done this occasionally when passing significant milestones in its career; and with the current change from weekly to monthly publication the time seems opportune to formulate anew an expression of our faith and purpose.

CHEM. & MET. is a magazine of opinion written for that large group of men who are responsible for production and administration in the chemical engineering industries. Thus its major editorial field is the technology and economics of those industries; the goal of its efforts is production efficiency and business success. On this platform the magazine becomes a common meeting ground for the fabricator of chemical engineering equipment, the producer of commodities that form the raw materials or finished products of various industries, the buyer and seller, the engineer, the plant operator, the business executive.

WE BELIEVE in chemical engineering in industry; in the intelligent application to production methods of chemical, physical and mechanical principles. We believe in the efficiency, economy and ultimate profit of engineering methods; in the displacement of manual labor by mechanical handling; in the use of modern engineering equipment and automatic control; in the development of continuous processes wherever possible. We believe in the direct and beneficent influence of these factors on national prosperity and individual standards of living.

WE BELIEVE in extensive and intensive application of the engineering method—the determination of facts and their honest interpretation — not only in research, development and production, but also in those more neglected but equally important phases of business — purchasing, marketing, management and financing. We believe in thus forestalling the element of surprise in business; in eliminating the casual; in substituting knowledge for "hunch."

WE BELIEVE in the conservation of material resources through intelligent use; in the elimination of waste from our industrial life and the conversion of by-products into useful and profitable commodities. As exponents of technical publicity we believe in the open exchange of technical information, knowing from observation and experience that industrial progress is thereby advanced by leaps and bounds. We abhor and expose the industrial charlatan as the enemy of honest chemical engineers.

FINALLY, and fundamentally, we believe in chemical engineering education and industrial research as two great factors that will banish empiricism and rule-of-thumb from industry and place it on the firm foundation of science and engineering.

WITH US these things are more than a mere formula or catch word. They constitute a creed in chemical engineering and a goal for industrial achievement. They are the things in which we believe fundamentally. As an expression of faith, they connote also a pledge of service to which we are committed, and only in the performance of which we shall merit approval and success.

A Program for Using Bituminous Coal

WHATEVER one may think of some of the details of the plan envisaged in the recent report of the Giant Power Survey Board of Pennsylvania, the general scheme is noteworthy. It is the first attempt to establish, on the basis of a whole state, a co-ordinated program for the full utilization at maximum efficiency of all the available power resources, coal, gas, oil and water. While the recommendations of this particular report may never be adopted, it serves to indicate that political powers are at last aware of the future power needs of our country, needs that have long been evident to engineers and scientists.

From the chemical engineer's viewpoint the most important part of the report is the section written by Judson C. Dickerman, Assistant Director of the Survey Board, on the "Pretreatment of Bituminous Coal." This section of the report opens with a recognition of the fact that the potential values in raw coal, now wasted when the coal is consumed untreated, must be recovered as by-products in order to guarantee a supply of raw materials to our chemical industry and to do away with that menace to health and property—smoke.

The report then studies, in some engineering and economic detail, the methods so far developed for the recovery of these by-products and the elimination of smoke and concludes with a series of recommendations for the future utilization of the bituminous coal supply so suggestive that we give them here in full:

1. Bring to the mine mouth a far larger percentage of the combustible present in the seams encountered in the mine than now.
2. Sort, screen, or wash at or near the mine mouth the mined coal to purify, and prepare for
3. Shipment raw only to such industries as large steel plants, and large gasification works which can to advantage by-product their coal supplies
4. Carbonization at or near the mine by high temperature ovens, to supply the demand of blast furnaces, foundries, etc., which can not well operate recovery plants yet need metallurgical coke.
5. Carbonization at or near the mine by low temperature processes. The product to be powdered and sold ready for dust firing, both for power and all heating processes except in smaller furnaces and stoves. For these, naturally formed lumps of the low temperature coke, or briquettes made from the fine material would be prepared for sale. Only limited amounts of this solid fuel would be required, since in the larger communities much of the small demands for heat would be met by gas, and large consumers would use powdered fuel.
6. Production of electric power in large volume by burning the "breeze" and other low grade fuel material or surplus by-products; transmitted at high voltage across the state, using rights-of-way jointly with gas transmission mains, and possibly powdered emulsified coal mains.
7. Production and transmission of fuel gas as a result of carbonization to be distributed in small hamlets along and near the transmission pipe lines as well as in large cities for general heating purposes.
8. Production of motor gasoline and Diesel engine oil fuel from the oil tar by-products for automobiles, ships, and isolated or temporary power purposes where the extension of electric service is impracticable.
9. Production of ammonium compounds and of chemical base materials from the tars and liquors.
10. Associated chemical and electrochemical industries requiring cheap power, coke, gas and other by-products, such as the Claude process for making ammonia, calcium carbide process, roofing and road materials, etc.
11. The preparation of emulsified coal fuel to be transported in tank cars or possibly by pipe lines, and to be used in oil burners for large and small heating plant purposes.

Truly, here is a program that is worthy the strongest backing that the chemical engineering profession can give it. Once established, it would place the chemical engineering industries securely on a higher plane than they now occupy.

Sugar As a C. P. Chemical

IF REFINED SUGAR were a chemical commodity rather than a food product, we should have a keener appreciation of the fact that it is one of the cheapest C.P. chemicals. Produced in the United States at the rate of nearly 5,000,000 tons per annum, its purity and cheapness are tributes to the efficiency of the chemical engineering operations through which it passes from cane or beet to finished product. There are few other industries in which responsibility for production has so rapidly fallen into the hands of the chemical engineer during the past decade. Consequently our readers will find material of exceptional interest and value in the leading article in this issue describing the technology of sugar refining at Crockett, Calif.

The economic problems involved in a business of such magnitude, subject to seasonal fluctuations in the supply of raw material and in the demand for the refined product, are such that ultimate commercial success is possible only by a rigid and unremitting attention to detail, by the utilization of every known scientific and technical help to efficiency and by continuous research in the mechanical as well as the chemical phases of operations. To the economist, the operation of a basic industry of this character must prove stimulating and suggestive. Whatever the objection to centralized control, the factor of cheap production in consequence of the application of the results of intensive research, possible only when adequate funds are available, cannot be overestimated. In this particular instance, consumers have had the full benefit of business initiative and the scientific control of operations, and a low price for sugar is the result.

To the technologist the work being done at Crockett is of especial significance, because of the achievement of success in details and the smooth engineering correlation in evidence throughout the plant as a whole. Much of this is doubtless due to successful team work among the staff; and there is ample indication that the reins of plant management connect with every phase of operation. In few plants of the size and character of the works at Crockett, employing so many men of different types, aspirations and ambitions, is one privileged to observe the practicability of a scheme of control and management that has for its foundation a wholesome respect for cleanliness and order. Experience shows that technical failure is often if not usually the result of indefinite thinking and inadequate planning, followed by an untidiness of application that makes exact performance a physical impossibility. If there is one detail on which too much stress cannot be laid in the utilization of science by industry it is in the primary requirement for that order of things mental as well as material that insures a definiteness and neatness that is so essential to precision.

Tariff Developments— In Prospect and Retrospect

IN SPITE of the fact that the Administration has officially frowned on the rumors that a general revision of the tariff is imminent, the question will not down and industry may well face the prospect. To be sure neither of the political parties was able to stir up any appreciable interest in the tariff during the last campaign, but it must be appreciated that it does not always take an electoral mandate to start the traiff bee buzzing among members of the Ways and Means and Finance Committees. Green-Smoot or Smoot-Green is just as euphonious a name, to certain ears at least, as Fordney-McCumber or any of the other famous combinations of history. But quite aside from politics there are a number of conditions and developments that serve to make the tariff a live issue—notwithstanding the wishes of the President and the country that business should not be disturbed by a general revision.

In the first place there is the experiment of the so-called flexible tariff, which in the opinion of many has already demonstrated its worthlessness. Certainly even its most ardent proponents must admit that it has fallen far short of the high hopes held for it at the time the 1922 tariff act was framed. It will be recalled that the then unsettled conditions abroad made tariff making a hazardous undertaking and at the last minute section 315 was written into the law in the hope of providing an elastic means of correcting maladjustments in the rate schedules and of making the measure effective against rapidly changing conditions of international competition. The signal weakness of the scheme, however, is that it was based on production costs at home and abroad. From the start the foreigner was suspicious that it was merely an excuse to elevate duties to still greater heights and naturally his cooperation has been practically nil. Furthermore since the only applications of the law so far to go into effect have been to increase existing rates, the further chances of getting foreign costs have steadily diminished. But aside from the technical difficulty of administration, the measure has had the effect of injecting politics into the situation to such an extent that many believe a drastic reorganization of the Tariff Commission is necessary before it can ever function efficiently.

There are those who argue, with some justification, that this reorganization should be made on a frankly political basis; for to take "the tariff out of politics" is, after all, merely an ideal impossible of actual accomplishment. Friends of this scheme hold that the party in power, receiving its tariff instructions from the electorate, should be given a majority of the Commission's membership which would comprise 5 or 7 members organized in the same way as congressional committees. This would avoid the deadlocks and indecision that have lately throttled progress in reporting investigations and recommending conclusions to the President.

In decided contrast is the plan of the Institute of Economics, recently proposed by Thomas Walker Page, in an interesting and thoughtful book on tariff making. This would provide for a smaller commission of but 4 men of highest calibre and the commission would be engaged primarily in fact finding. It is recognized that rate making must continue to be the prerogative of Congress, but it is also apparent that that body cannot be expected to assemble the necessary facts and data and apply them intelligently. It remains, therefore, for a permanent tariff commission to prosecute investigations and report them accurately, completely and without bias.

After all, the two political parties are not so diametrically opposed in their tariff views as many people think. Both believe that basically there should be a certain equality of opportunity that will put the American, with his higher standards of living, on an even basis in meeting his foreign competitor. One party would stop here with a "competitive" tariff, the other would add "reasonable protection." Therefore, it is both logical and consistent that a tariff commission organized on a fact-finding basis should be allowed to interpret the facts into suggested rates that might be expected to meet, exceed or be less than those required for the condition of competitive equality. Facts thus made known not only to Congress but to the country at large, would mark the first step toward a badly needed reform in our system of tariff making.

The chemical industries have seen more of the flexible tariff experiment than other industries, for a majority of the Commission's investigations and reports has dealt with commodities in this field. Yet there remain many instances of inequality and maladjustment that are deserving of attention. In the case of dyes, the American valuation scheme has been tried out with considerably more success than its opponents thought possible. The Commission through its surveys, cost studies and censuses of production and imports has been doing a service that has proved invaluable to chemical manufacturers. Nevertheless these industries are deeply interested in the more fundamental changes that are necessary in order to make the whole program more effective. Many of the modifications proposed in our tariff system are of vital significance to the chemical industries and it is hoped that they will recognize their obligation to contribute constructive thought and action to the solution of this great problem.

A Genial Friend of Chemical Industry

AS the 68th Congress passed inconspicuously out of existence on March 4, it left behind it important, but unfinished, business. It did one thing, however, for which we can find no fault. Its selection of Nicholas Longworth for the speakership of the 69th Congress was most fortunate, and particularly gratifying to the chemical industries whose interests he has consistently supported with keen vision and a broadminded sense of fairness.

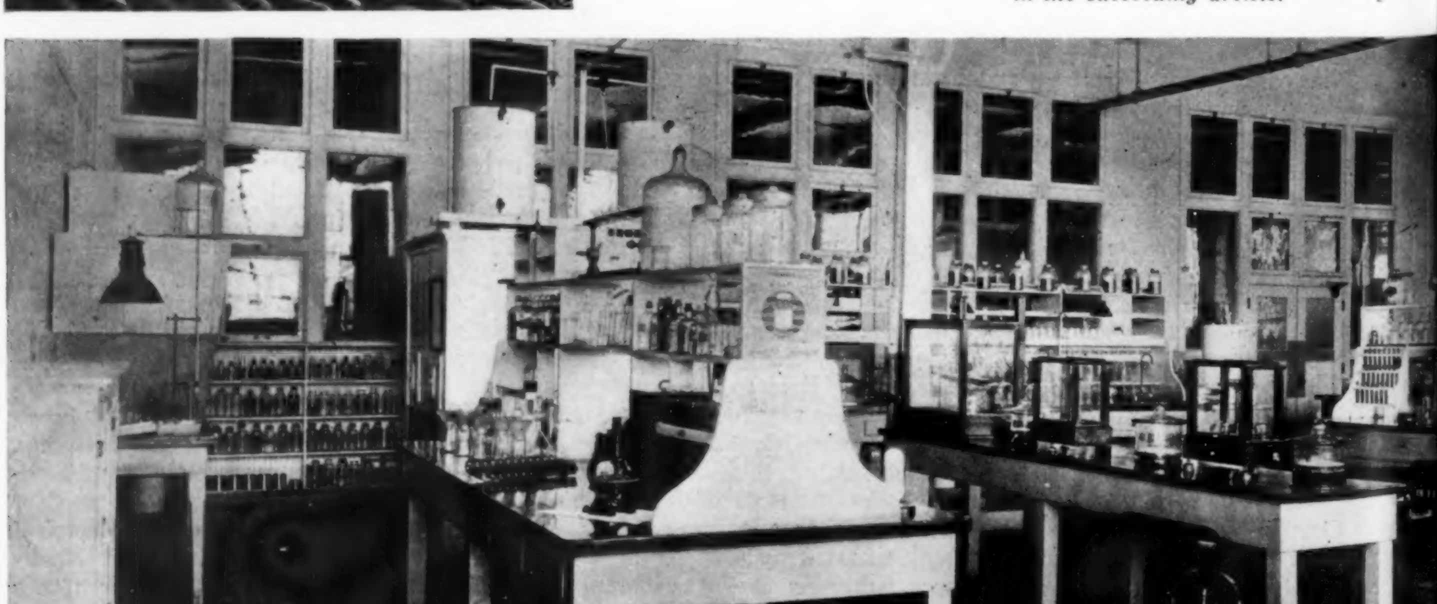
The new speaker brings to his distinguished position a rare combination of ability and amiability that has made his leadership in Congress a unique record of accomplishment. His unfailing sense of humor and his good natured comment have proved wonderful lubricants in expediting legislation through the creaking, friction-bound machinery of Congress. His sound business judgment and remarkable ability as an organizer were clearly reflected in the handling of the chemical schedule of the tariff act for the Ways and Means Committee. His spectacular fight on the floor of the House for the ill-fated Longworth bill did much to bring about the protection that was finally granted to the domestic dye and organic chemical industries. His selection brings to a genial friend an opportunity for greater service and greater influence.

Random Views of a Great Sugar

VIEW OF THE PLANT *of the C.-H. Co. at Crockett, Calif., showing the advantageous location on deep-water navigation and on the main line of a transcontinental railroad.*

THE WAREHOUSE *of the California & Hawaiian Sugar Refining Co. has a capacity of 150,000 to 175,000 tons of raw and refined sugars, thus forming an adequate reserve against abnormal periods of supply and demand.*

THE LABORATORY *of a plant is often an indication of what may be expected in the manufacturing departments. This case is no exception and the promise of the splendid laboratory shown here is fulfilled in the plant described in the succeeding article.*

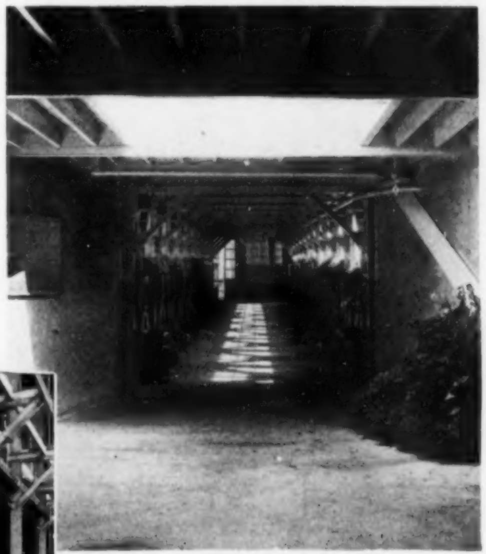


Refinery

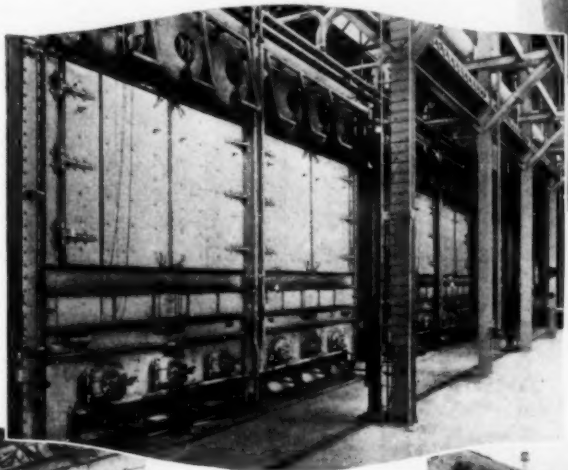
Plant of the California & Hawaiian Sugar Refining Co. at Crockett, near San Franc.sco, Calif.

The largest of its kind in the world with a capacity of 2,500 tons of refined product daily

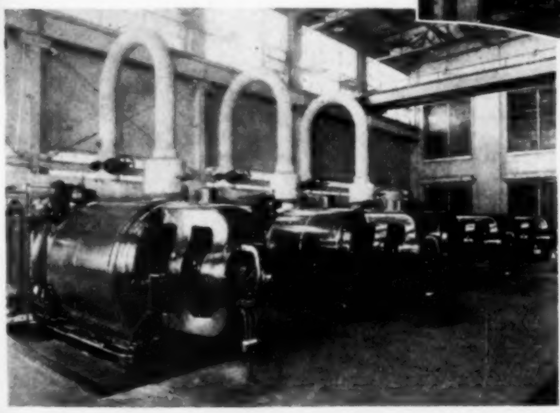
THE BOILER HOUSE *contains* 23 *units and has a total rated capacity of* 10,150 *boiler-hp. The fuel used is oil and combustion control is maintained through the use of adequate controlling instruments.*



THIS VIEW OF THE BRIDGE *leading from the office to the refinery is evidence of the belief that this company has in the fact that pleasant surroundings make efficient and contented workers.*



THE POWER PLANT *contains four* 1,500-*kw. turbo-generator units. The turbines are non-condensing units and act as reducers for the steam needed for heating, evaporation, drying and other uses.*



CROCKETT *is an ideal industrial community and the community auditorium and tennis courts shown here are evidence of some of the methods taken by the company to make it so.*

Manufacture of Refined Cane Sugar

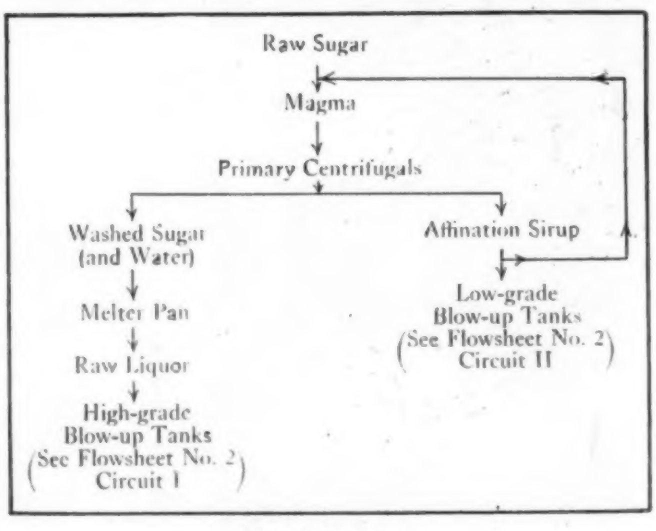
A Description of the Plant, Processes and Technical Achievements of the California & Hawaiian Sugar Refining Corporation

By A. W. Allen
Assistant Editor, Chem. & Met.

The attainment of mere bigness is not in itself worthy of especial commendation. As connoting a co-ordination of interdependent activities and allied interests, whereby costs are reduced, sufficient financial stability secured to resist successfully the periodic industrial depressions that would flatten an impecunious operator, and permit adequate attention to research in the application of science to industry—as such, bigness is to be welcomed for the good of the majority. The California & Hawaiian Sugar Refining Corp. has been first in the field of pioneering intensive experimentation in the technology of sugar refining. It has been unstinting in planning and expenditure to promote a better understanding between employer and employee, in an effort to stabilize production and to insure an ample supply of a valuable and exceptionally pure food product at a reasonable cost to the consumer. The publication of these notes indicates that the corporation has adopted an enlightened policy of frank and wholesome publicity in regard to details of handling and processing. The plant to be described is one of the show places of the West; and, it may be added, visitors are always welcome.

UNTIL comparatively recent times almost all the raw cane sugar produced on the Hawaiian Islands was shipped via Cape Horn to eastern plants. In 1904 a corporation, Sugar Factors Co., Ltd., was formed to erect and operate a refinery in California. In 1905 a beet-sugar plant at Crockett, near San Francisco, was purchased. This was reconstructed and new equipment installed. The company was reorganized and commenced operations in March, 1906, as the California & Hawaiian Sugar Refining Corporation. The output has been increased and the plant has been modified in minor details from time to time; it now ranks as the largest unit of its kind in the world, with a rated capacity of 2,500 tons of refined product per day. It handles by far the largest proportion of the output of raw sugar from the Islands, the remainder going to the plant of the Western Sugar Refining Co., in San Francisco, owned by J. D. and A. B. Spreckels, whose father, Claus Spreckels, deserves credit for pioneer initiative in establishing the refining of sugar as a basic industry in the Coast region.

The proportion of the total supply of raw product from the Islands that goes to the plant at Crockett is about 80 per cent, representing the output from 33 of the plantations in operation. The California & Hawaiian refinery is owned by these 33 plantations, representing an aggregate capital and surplus of over



Flowsheet No. 1
The preparation of sugar liquor

$120,000,000. Supplies for its operation are drawn largely from local sources. Fuel oil, costing $600,000 per annum; bone char, $75,000 per annum; kieselguhr, $75,000 per annum, and chemicals, $40,000 per annum —all are Californian products. Among major expenses for sundry supplies from outside sources may be mentioned the sum of $1,000,000 or thereabouts per annum for cotton sheeting, from the South, for inner bags, and $100,000 per annum for jute or burlap, from India. Freighting and insurance, for the transport of the raw and refined products to and from Crockett aggregate about $5,700,000 per annum. These figures, representing a few of the major items of expense, indicate the immensity of operations.

Manufacture of Cane Sugar

The preliminary operations at or near the plantation serve to produce raw sugar containing about 96 to 97 per cent of sucrose. The cane is crushed between rolls and the resultant juice purified by treatment with lime and heat and by settling the solid impurities. Evaporators are used to concentrate the clear liquor to a thick syrup and crystallization is brought about subsequently in vacuum pans. The product, a mixture of comparatively coarse crystals and molasses, is centrifuged and the resulting raw sugar is packed in jute bags. These are shipped in special freighters of the Matson Navigation Co. to the refinery at Crockett. Much of the molasses produced at the plantations is shipped to the United States, to be used for the manufacture of industrial alcohol, stock feed or vinegar.

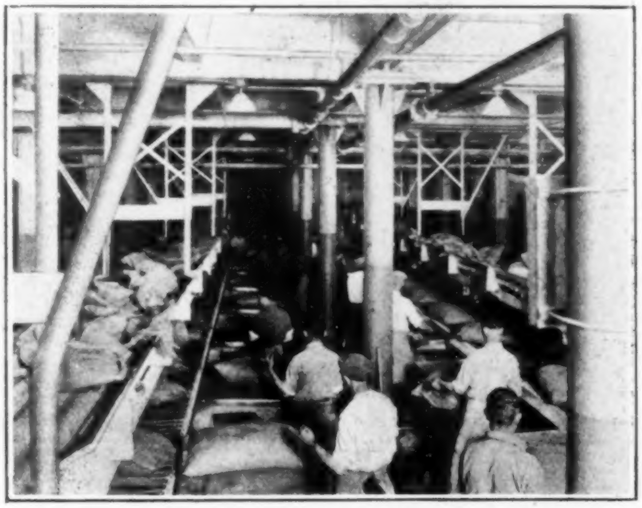


Fig. 1—View in the Opening Department
The bags of raw sugar, after being sampled and counted, are opened and the contents dumped through a grating.

The plant is ideally situated except in one particular: Water must be brought by barge and tugboat from the north short of San Pablo Bay, 15 miles from the refinery, the supply coming by gravity to this point through pipes from Marin County. Crockett is situated about 30 miles from San Francisco on the Straits of Carquinez, across which a bridge is now being constructed, and the immense refinery is familiar to transcontinental travelers who use the Southern Pacific System, the main line of which passes through the property. Wharfage is ample, and complete facilities are provided for the unloading of at least 16,000 tons of raw sugar per 6-day week. In view of the recent disaster at Avon, Calif., and the loss of life from fire—caused by the collapse of the wooden supports of a wharf, in consequence of the ravages of the *Teredo* borer, a mollusc that inhabits San Francisco Bay—it is interesting to note that the C. & H. engineering staff initiated the research that led to a scientific appreciation of the dangers involved; and proceeded to replace its own wooden wharves with permanent concrete structures, at considerable expense.

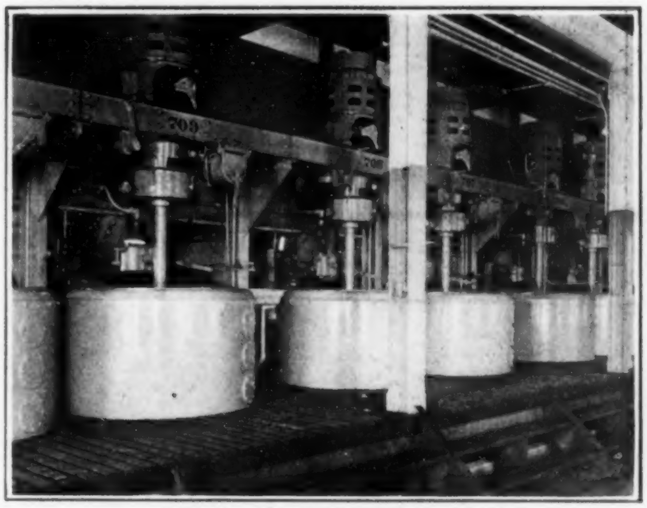


Fig. 2—Some of the Centrifugals Used
The centrifugals for washing raw and refined sugar are motor driven and equipped with mechanical and electrical devices for the precise control of wash water.

The Crockett refinery operates for 12 days continuously, then shuts down for two days. This arrangement, welcomed by employees and employers alike, permits the reservation of one day in seven to all workers, and enables the mechanical department to keep the equipment in first-class condition.

Constant improvement and development is in evidence to minimize handling costs by the maximum possible use of mechanical equipment. (Conveying equipment installed at the wharf in 1924 has obviated the employment of 35 truckers.) On arrival of the raw sugar at Crockett, its grade is determined by tests made on samples taken from each sixth bag unloaded, a tryer scoop being used, which is driven through the unopened bag. The sampling is done by an independent concern, checks being delivered to the refin-

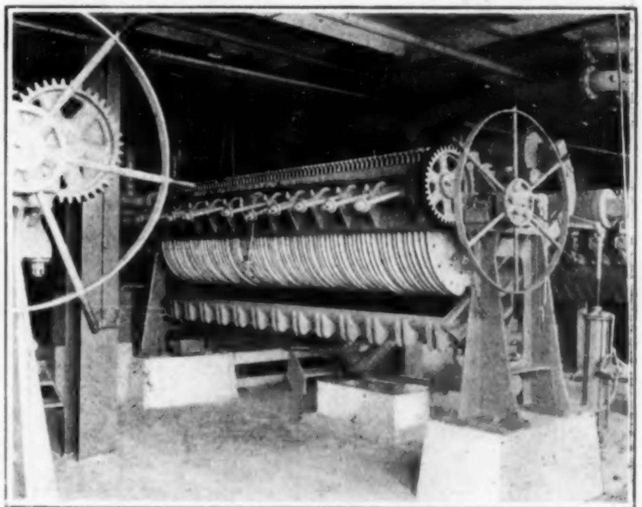


Fig. 3—One of the Pressure Filters
There are 38 of these filters used for the clarification of raw juice, on the leaves of which a smear of kieselguhr is first formed to act as a filter for the bulk of the liquor.

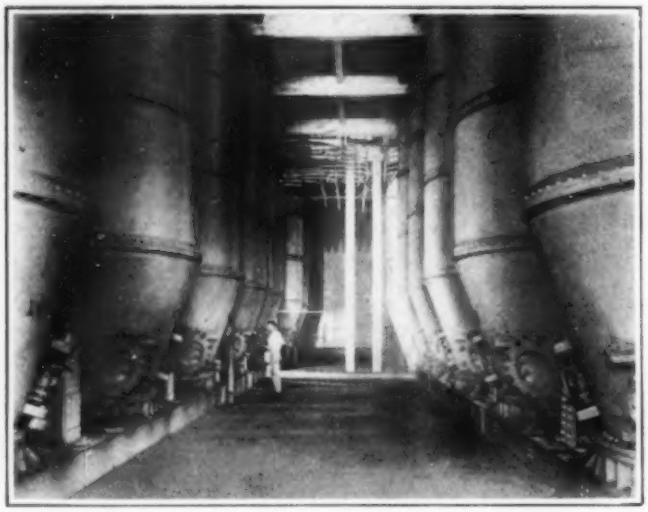


Fig. 4—Char Filters for Decolorizing the Sugar Liquor

There are 108 of these filters, 10 ft. diameter by 25 ft. high. The discharge doors for the removal of the spent char are shown near the bottom of the cone.

ing company and to the plantation. Agreement is usual; in the event of dispute, the sucrose content of an umpire sample is accepted as correct.

Formerly, the bags of incoming sugar were loaded, in lots of five, by hand onto a truck for weighing. Recently a new system was installed, whereby weighing is accurately and inexpensively performed, the tryer sample being obtained, as mentioned above, from each sixth bag. Accuracy is essential in the recording of the weight of a material of such a comparatively high value, especially in view of the immense tonnage being handled. Automatic weighing on a moving belt conveyor, as practiced in the metallurgical industries, is hopelessly inaccurate for the refiner of sugar. The average error may amount to 1.5 per cent. The weighing of sugar by hand is inevitable in a refinery taking the output of several plantations, personal supervision being necessary to group the output from each. The plan successfully adopted at Crockett involves the weighing by rapid hand adjustment of a short length of conveyor, on which six sacks of sugar are placed. The deflecting of the bags with hook to the appropriate moving platform is done so quickly, the adjustment of

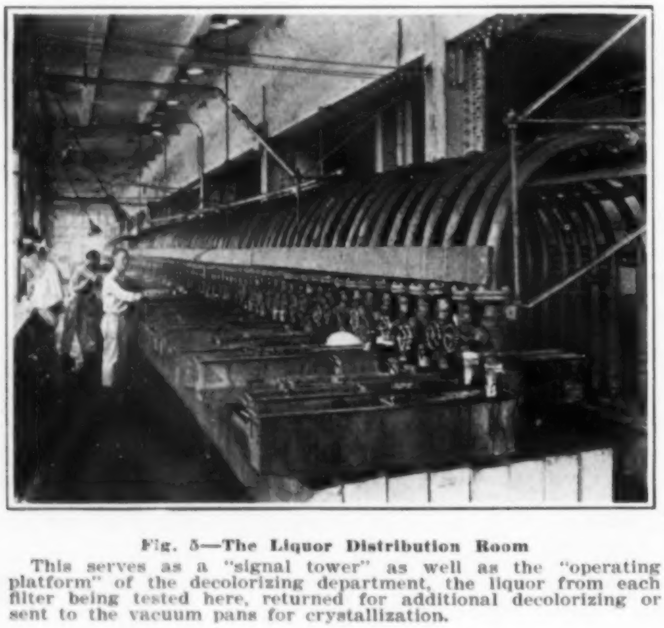


Fig. 5—The Liquor Distribution Room

This serves as a "signal tower" as well as the "operating platform" of the decolorizing department, the liquor from each filter being tested here, returned for additional decolorizing or sent to the vacuum pans for crystallization.

the scale is so rapid and the result is so accurate that the ideal of cheapness and efficiency appears to have been attained. With the large quantities of raw product being handled at Crockett daily it is evident that moisture content must be estimated before appreciable evaporation has occurred in the sample. To minimize error in this connection steps are to be taken to provide a room where humidity and temperature are kept constant during the handling and the quartering of the samples.

Storage for 150,000 to 175,000 tons of raw and refined sugar is available to form an adequate reserve in abnormal periods of supply and demand. The delivery system is planned so that the cargo as discharged from the ship can be sent direct to processing and thus avoid the cost of unnecessary storage and handling. An interesting feature in the delivery system is the electric control of the conveyors and the means of intercommunication between the supply and receiving departments. The total time taken to wash, melt, refine, crystallize, dry and pack the finished product is about

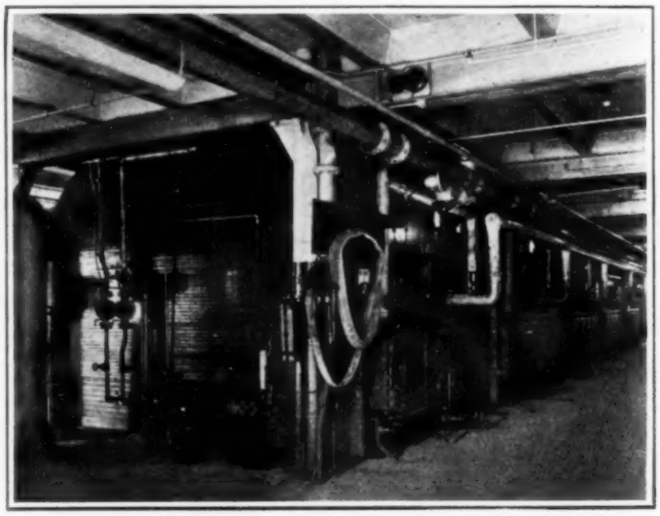


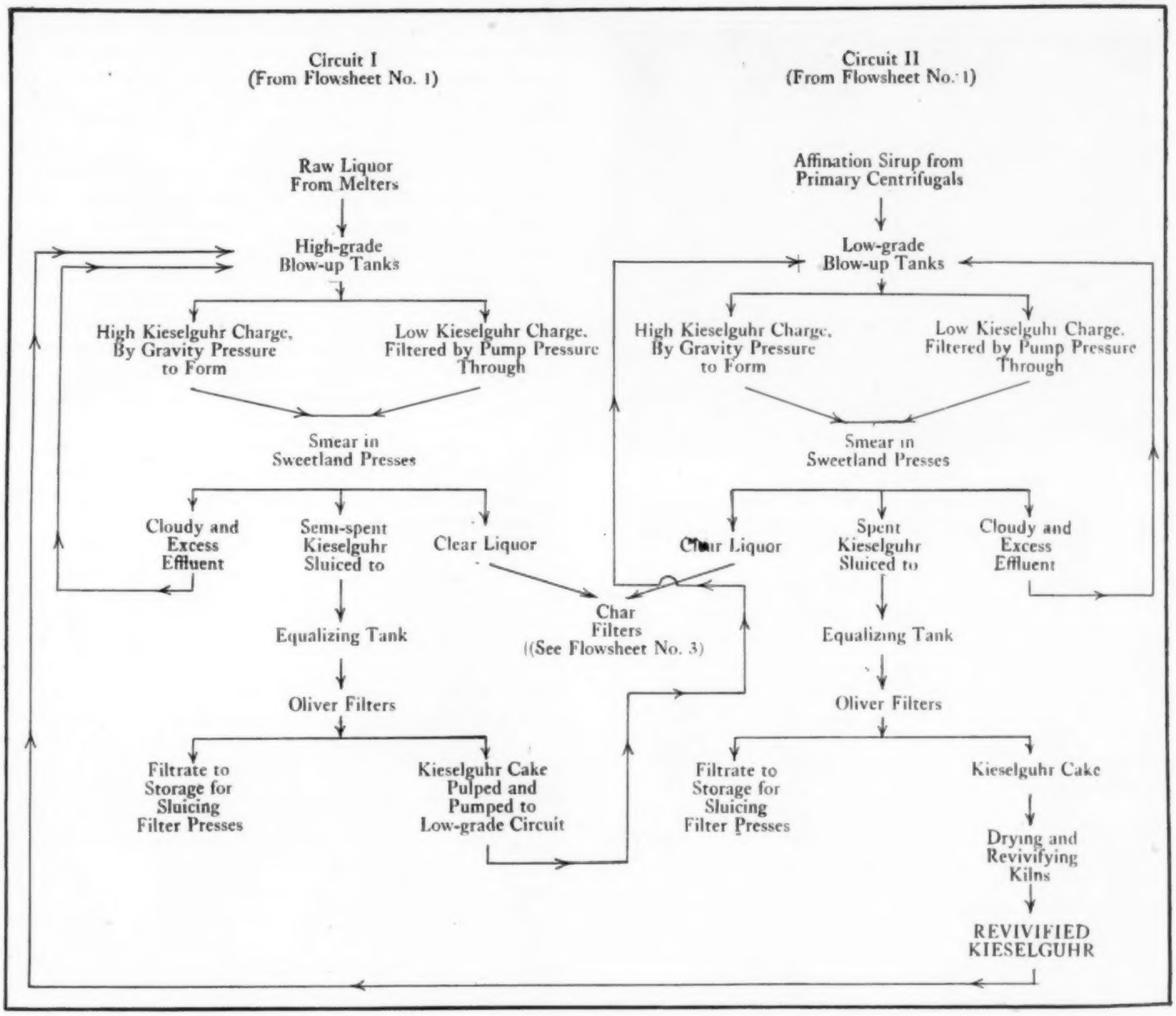
Fig. 6—Evaporators for Low Density Liquors

The low density liquors are thickened in this set of five evaporators which take a continuous series flow of 6,000 to 9,000 gal. of sweet water per hour, raising it from an average of 18 to 67 deg. Brix.

12 hr.; and in one part of the plant may be seen a 36-in. belt conveyor, on the top of which raw sugar enters the refinery, and on the bottom of which the bags of refined product leave the plant.

In a normal day's operation, the jute bags from the plantations, after the contents have been dumped by hand through a grizzly into the primary bin, contain about 6 tons of sugar. The laundering of these bags and the recovery of the adhering sugar is therefore an important step in the process. The "sweet water" resulting joins the other liquors of similar density, the sugar being ultimately recovered as a refined product. To facilitate accounting, the bags are marked at the plantations with washable ink, to designate origin; the same bags, repaired if necessary, lined with an inner cotton bag and printed in color according to the type of final product contained, are used for the refined sugar. After laundering, the bags are dried during passage on a hanging conveyor over the boilers.

The raw sugar, containing 96 to 97.5 per cent of sucrose, is discharged from the bottom of the storage bin by drag conveyor, and then goes to two mixers, termed minglers, similar in construction and operation



Flowsheet No. 2
Filtration of sugar liquors with kieselguhr and revivification of kieselguhr

to the machines used in the pottery industry for the pugging of clay. In these it is incorporated with sufficient crude syrup to insure fluidity of the mass and easy control of load into the centrifugals, where primary washing is effected. Twenty-two Watson-Laidlaw, self-discharging type machines are used, each being motor driven at a maximum sped of 870 r.p.m. A normal load of each is about 1,226 lb. of magma, as the mixture is called. The wash averages about 45 lb. per charge, the amount being controlled by a mechanically operated device. An automatic electrically operated baffle deflects the wash liquor into a separate channel from that taken by the syrup thrown off in the initial stages of centrifuging.

Washed sugar from the primary centrifugals, averaging over 99 per cent sucrose, is then ready for melting and refining. Attention may well be directed to the exceedingly small amount of impurities remaining, for the removal of which the most elaborate processing is necessary. However, this processing is not alone for the purification of the sugar; it makes possible the ultimate production of a saleable product in a wide variety of forms and character, each of which has its application in the economics of sugar as a food, in preserves, or for decorative or for flavoring purposes.

Filtration and Decolorizing of Sugar Syrup

It is pertinent to note that the filtration and decolorizing of the raw sugar liquor is an important phase of processing, to produce a clear and clean crystal or a snow-white powder. The work is done in two stages. Filtration, aided by an inert granular material, kieselguhr (this designation for diatomite, customary in the sugar industry, will be retained throughout this article) is followed by decolorizing with bone char. Pressure varies according to the resistance encountered. Gravity, from a height, is adopted in the initial stages of filtration and in the final stage of decolorizing. Pump pressure is used in the filter press after a layer of filter aid has been deposited on the leaves; and atmospheric pressure, induced by vacuum on the filtrate side of the medium in the continuous filters, assists percolation of wash water, and cleanses the filter aid of associated sugar.

Particular interest is attached to the use of kieselguhr to assist filtration, because it was at Crockett that the pioneer work was done with the Californian

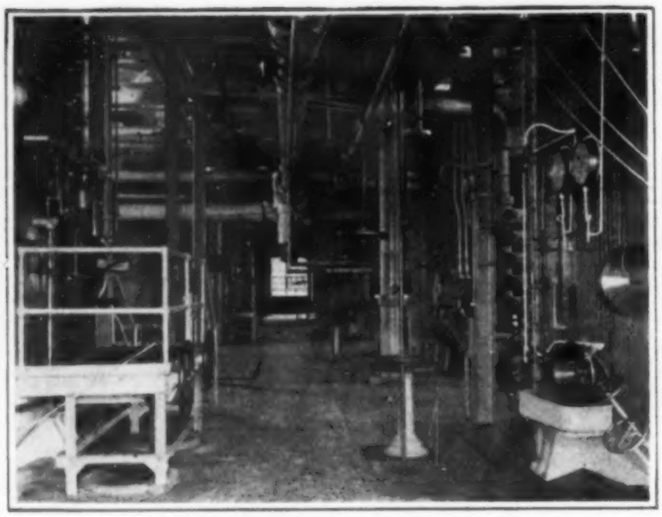


Fig. 7—Installation of Vacuum Pans

There are 14 single effect units in this installation, from 6 to 14 ft. diameter, for a load of 12 to 86 tons of massecuite or crystal-syrup and accessories for temperature and vacuum maintenance and provision for sampling and control.

product in connection with the purification of sugar juices. The washed sugar from the primary centrifugals, 710 lb. per charge, falls into a dissolving tank, known as a melter, where sufficient hot water is added to produce a dense liquor with a moisture content of about 37 per cent. This is pumped to the top of the building and distributed to 3 cylindrical tanks, each 10 ft. by 10 ft. 6 in., equipped with steam coils to heat the liquor to 80 deg. C. This reduces viscosity and insures efficient filtration. The capacity of the "blow-ups," as they are called, is 3,800 gal. apiece, 3,500 gal. being the normal load. The charge in each contains about 12 tons of sugar liquor. Kieselguhr is added in separate and distinct quantities: (1) To form a pulp by which a preliminary "smear" is obtained in the presses, and (2) to assist the filtration of the bulk of the liquor. In the former instance about 750 lb. of kieselguhr is added per tank, in the latter, about 75 lb. per tank. Compressed air is used to keep the mass in agitation and to prevent the settlement of solids, hence the designation "blow-up."

The heavier pulp, when properly mixed, is delivered by gravity to part of a battery of 38, No. 12, refinery-type Sweetland filter presses, each with 72 leaves and a filtering area of 1,044 sq.ft. This press is of the suspended-leaf, inclosed type. It consists essentially of a cylinder, divided along its horizontal axis into two parts, the lower of which is hinged to the upper, to permit the removal of cake or the cleansing of the filter leaves, the latter conforming to the shape of the cross-section of the cylinder. The two halves of the cylinder are provided with a packing joint, to withstand internal pressure when the press is closed; and each filter leaf is connected to a manifold through a sight glass, thus permitting the immediate detection of contamination in consequence of the rupture of the filter medium.

The high-kieselguhr liquor is delivered by gravity to the interior of the press, the filtration cocks and manifold being open; and in 5 to 10 minutes, a deposit of filter aid is formed on the leaves. The filtration of this high-kieselguhr liquor is continued until the filtrate is clear, the cloudy effluent being returned from the press goes back to the blow-up tanks. The feed is then diverted and replaced with liquor with the smaller load of kieselguhr. Pressure is obtained with a centrifugal pump to a maximum of about 60 lb. per square inch. The cycle of operation in each press occupies about 2 hr. 30 min., after which the cylinder is drained of surplus liquor, which is pumped back to the blow-up tanks.

Two separate systems of liquor are maintained, to insure against the contamination of the high-purity liquors by the low-purity syrups. Each system has its special apparatus. The clear liquor from the high-purity Sweetlands is ready for decolorizing with bone char. The cakes in the presses are then sluiced off with hot, low-density sweet water, without opening the apparatus, by means of a series of arcing nozzles, the resultant kieselguhr pulp going to an equalizing tank, thence to one of four 12-ft. Oliver vacuum filters. The cake from this, after "sweetening off," is pumped back to the low-purity blow-ups, where it is used once again as a filter aid, passing to the low-purity Sweetlands, thence to the low-purity Oliver filters. The kieselguhr is therefore used twice before passing to the revivification plant. The cake formed on the drum of the Oliver filter is sprayed with water, the filtrate going to the clear sluice tank, which supplies the sluicing water for the discharge of the cake in the Sweetland presses.

The Sweetland presses have bronze-wire leaves, covered with monel-metal screens for both the high- and low-purity liquors; they are opened every 8 hr. for inspection and, if necessary, for the thorough cleansing of the leaves by hose. The Oliver filters are equipped with monel-metal screens, 80-74 meshes to the inch. Phosphor bronze and nickel have been tried, but monel metal has been found superior. Brass or bronze has replaced iron generally in the fittings of the Oliver filters. The kieselguhr is abrasive. Pumps employed to convey it, as a constituent of a filter pulp, are provided with high-pressure gland water service, to minimize scoring of the shaft and to protect the packing. An unusually gritty kieselguhr is a poor filter aid; and it is therefore evident that strict standardization of product is essential to success and uninterrupted efficiency in the application of this material to the problems of clarifying sugar juices.

Bone-char decolorizing at the Crockett plant takes place in 108 char filters, each 10 ft. diameter and 25 ft. high. In all of these the filter cloth, of heavy cotton twill, rests on an iron plate perforated with small holes, placed about 4 in. above the bottom of the filter. The blanket is about 2 ft. larger in diameter than the tank

Fig. 8—Some of the Accessories Such as Syrup and Vacuum Pumps Used With the Vacuum Pans

at the point of support. The excess is available for edge packing, for which metal weights are used, held in place with wooden wedges. Fifty tons of char (minus 8 plus 24 mesh, specification, weighing about 45 lb. per cubic foot when new) is fed in to each tank with the sugar liquor, the exit valve being closed meanwhile. When the tank is full of liquor and char, the filling port is sealed, and a steady stream of liquor is delivered direct by pipe from the storage tanks on the floor above. The effluent pipe from each char filter is carried upward, so that the char is always submerged, irrespective of rate or amount of flow.

The rate of flow varies from 1,250 to 2,250 gal. per hour, depending on the product, the liquor remaining in contact with the char for from 1 to 4 hr. After 12 to 60 hr. of service, depending on the product filtered, the char becomes impaired, indicated by a failure to decolorize satisfactorily. The filter is then drained, the syrup being returned to the filter circuit. The char is "sweetened off" with hot water, to recover the greater portion of sugar, washed with hot water, then discharged through manholes near the bottom.

Fig. 9—The Sweater, a Rotary Drum Drier

The refined and washed sugar from the secondary centrifugals goes through this sweater, in which a current of hot air reduces the moisture content from 1½ to 0.1 per cent.

The blanket is washed between each cycle, and removed for repair, if necessary. The problem of insuring an intimate mixture of char and syrup in the first instance was one that involved considerable research. As mentioned before, both are now added simultaneously, thorough wetting being effected by an ingenious arrangement of staggered funnels, placed in the neck of the filter. In view of the importance of close control of the color of the various liquors, the correct handling of these to and from the char filters involves considerable personal attention. The liquor distribution room, where samples are continuously being taken of all inflows and effluents, is the "signal tower" as well as the "operating platform" of this part of the plant. Here the liquor from each filter is tested, returned for additional decolorizing or sent to the vacuum pans for crystallization.

Carefully controlled heating is the essential step in the treatment of spent kieselguhr or bone char, whereby each is made available for further use as a filter aid and as a decolorizing adsorbent, respectively. It is worthy of note that the practicability of the revivification of kieselguhr was first demonstrated as a result of

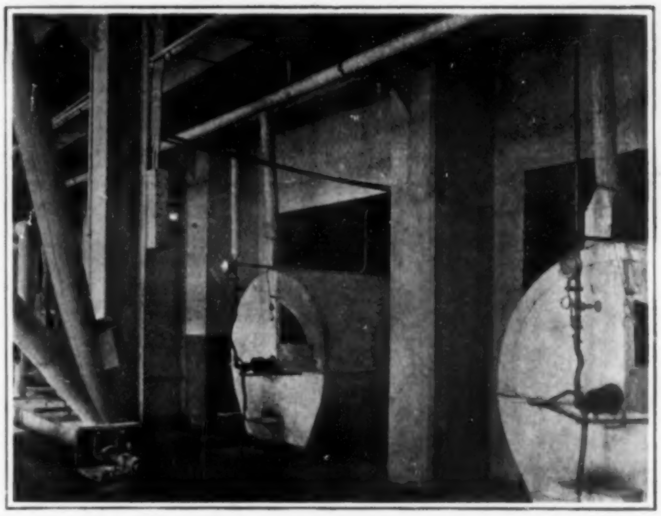


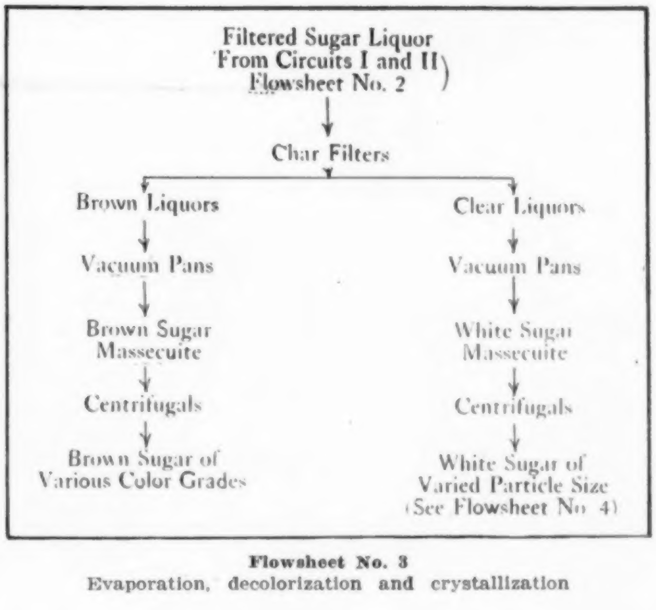
Fig. 10—The Granulators for Final Drying

The sugar is finally dried in these revolving drums each of which contains a steam-heated cylinder that moves with it, against which the sugar comes in contact during its passage from intake to discharge.

pioneer research by the C. & H. technical staff. After double usage, the cake from the Oliver filters that handle the sluicings from the low-purity Sweetlands is passed through two revolving kilns. The first of these acts as a drier, and the material is deprived of sufficient water to permit disintegration by a pair of rolls, placed between the two kilns. In the second kiln the temperature is raised by oil fire to about 1,200 deg. F., whereby the activity of the kieselguhr is restored. The dust is collected by water spray, and the pulp is dewatered on an Oliver filter before being returned to the blow-up tanks.

The bone-char retorts are of the standard type, 80 forming a kiln, of which 45 are in use. The nominal output is 50 cu.ft. of char per kiln per hour. Temperature is maintained, by pyrometer control, at 500 deg. C., as indicated at a point between the two rows of retorts on the outside. Dust is removed during passage over 5 Hummer screens, equipped with 70-mesh wire cloth (0.073 in.), the undersize being sold. The product of the kilns passes over a magnetic pulley before going to the screens.

Low-density liquors—light sweet water—are inspissated in a series of five Kilby evaporators, each with



Flowsheet No. 3

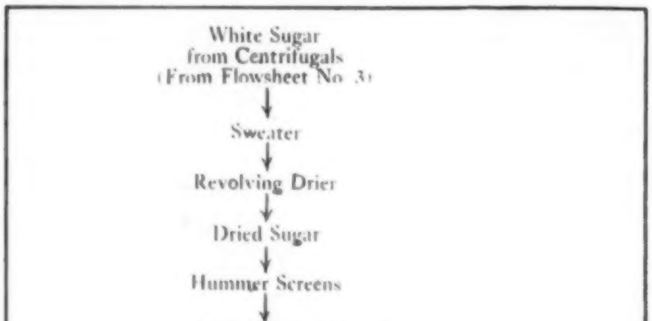
Evaporation, decolorization and crystallization

1,152 brass steam tubes. The flow varies from 6,000 to 9,000 gal. of raw material per hour, passage being continuous, through all five units in series, the first being under pressure, the last under vacuum. Concentration of the incoming liquor varies from ½ to 40 Brix, of an average of about 18 Brix; it leaves at 67 Brix, or thereabouts. Regulation of density, and work performed in these evaporators, is controlled by steam pressure and rate of flow. The production of concentrated sweet water varies from 35,000 to 40,000 gal. per 24 hr. This goes to the filtration and decolorizing units, then to the low-grade vacuum pans.

Fourteen single-effect vacuum pans are in service at Crockett, from 6 to 14 ft. diameter, the load varying from 12 to 86 tons of "massecuite," as the crystal-syrup product is termed. Eleven of the pans are of the coil type; three are equipped with calandrias. Some of the pans are set aside for the production of a low-grade sugar, which is again remelted and refined. Bronze or copper pans are used entirely for the production of fine sugar of the highest grades. The cycle of operations in a vacuum pan is essentially as follows: Concentration, by evaporation at low temperature and high vacuum, is continued until a point is reached at which crystallization will occur throughout the pan on the addition of a bucket of "seed," or small dry sugar crystals of the appropriate size. According to the character of the product required, the growth of the crystals is continued by the addition of more liquor to the pan while evaporation continues. Temperature control, of course, is an important factor.

Centrifuging and Drying

The mixture of crystallized sugar and syrup from the vacuum pans is discharged into a V-bottom bin, from which it is drawn as required into a battery of 44 centrifugals, of American Tool & Machine type. The regulation of wash is effected by means of an electrically operated mechanism, developed by the company's



Flowsheet No. 4
Drying, grading and grinding white sugar

Fig. 11—Screens for Grading Sugar
The dried sugar is separated into three grades by treatment in this battery of vibrating screens. The dust produced is collected by suction, remelted and returned to the evaporation circuit. Powdered sugar is a specially ground product.

engineering department. Electric current is used to operate a relay that, at the termination of a definite number of seconds after maximum speed has been reached in the centrifugal, makes connection which opens a water valve and allows it to remain so for a predetermined period of time. The centrifugals are discharged by hand operated scraper, the product, containing about 1½ per cent moisture, going to two revolving drum driers in series, each 6 ft. diameter and 30 ft. long. The first, locally known as the sweater, is fitted with baffles to lift the sugar and sift it through the hot air which is provided by heater coils and a suction fan. Moisture is reduced to about 0.1 per cent in the sweater; and to an inappreciable amount, about 0.06 per cent, by passage through the second drum, which contains a steam-heated cylinder, about 24 in. diameter, placed in the center of the drum and revolving with it, against which the sugar comes in contact. The dust from the "granulators," as the driers are termed, is collected by water spray and returned to the evaporation circuit.

The dried product, granulated sugar, passes over an electromagnet forming the tail pulley of a belt conveyor, then to 10 Hummer screens, each with two sieves, 3 ft. by 4 ft. 9 in. Three products result, known respectively as "berry," "standard" and dust. The dust is collected by a suction system, remelted and returned to the evaporation circuit. Special 15-cycle, alternating current is provided for the vibration of the Hummer screens.

The finest sizes of C. & H. sugar, "powdered" and "dessert," are prepared by grinding "berry" or "standard" sugar in Mead disc mills. The product is screened through silk cloth, and the oversize is returned to the grinders. A suction system removes the dust, which is settled in single-wall, burlap chambers. This is remelted and returned to the main liquor circuit. The grinding plant is situated at a considerable distance from the main refinery building, beyond the warehouses and shipping department. This provision indicates that the company is awake to the danger of dust explosion, and has taken every precaution to eliminate the possibility of it. Electric light fittings are protected with double globes, and provision made against the ignition, by sparking or overheating, of those parts of the equipment where the atmosphere is laden with

sugar dust, which is well-known to be explosive.

The refinements in processing at the C. & H. plant make possible the production of several varieties, with particular reference to the size of the crystal, to serve all conceivable purposes and tastes. Local prejudice must be taken into account; and it is a significant fact that sections of the United States show marked preference for sugars of a certain grain size. Moreover, the manufacturer cannot dictate the character of the package in which the sugar is supplied. In spite of obvious disadvantages in that type of container, the barrel—from which the customer's requirements are dipped and weighed, with concommittant loss, contamination, unnecessary labor and expense—is still popular in some places; but bags, varying in weight from 2 to 100 lb., are becoming more and more popular, and the bulk of the output is sold in these containers.

The coarsest product made at the Crockett plant is known as "rock crystal," followed by "confectioners' A" and "confectioners' AA." Each type is produced by special manipulation of operations in the vacuum pan. The Hummer screens, taking the product from the granulators, produce "berry" and "standard granulated," the former being the finer grained of the two.

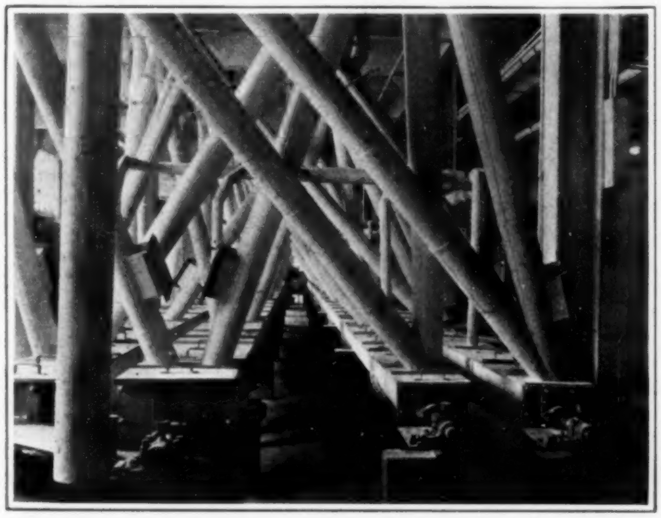


Fig. 12—The Sugar Is Conveyed in Chutes and Screw Conveyors

Among the so-called brown sugars, the following varieties are prepared: "Extra C," light brown; "golden C," medium brown, and "yellow D," dark brown. These sugars are prepared in the customary manner, but from syrups that have not been decolorized completely in the char filters.

"Cubes" and "cubelets" are made from a special granulated white sugar to which is added a sufficiency of pure syrup to act as a binder. The Hersey machine used to fashion the cubes is ingenious and complicated; when ejected they are friable and moist. Drying, on galvanized-iron sheets in steam-heated ovens, results in the cementing of the mass and the formation of the characteristically hard "lump" sugar.

The power plant acts as a pressure reducing system for the steam needed for heating, evaporation and other purposes in the refinery. It consists essentially of four 1,500-kw. Curtis, turbo-generator units, of General Electric manufacture. The average total load is 3,900 kw., with an occasional peak load of 4,200 kw. About 1,000 motors are in use. All except those operating the Hummer screens take 60-cycle, 3-phase alternating current at 440 volts. The turbines are operated at

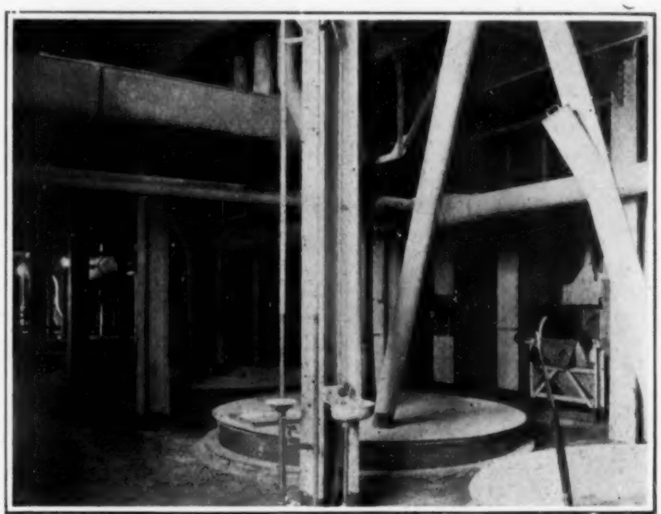


Fig. 13—Storage Bins for Sugar Are Closed Tanks With a Suction System for Taking Out the Dust

10 lb. back pressure, any reduction below this minimum being adjusted by the addition of high-pressure steam to the main going to the plant.

It is interesting to note that the C. & H. power plant is occasionally of service to local industry in providing current in times of emergency, caused by hydroelectric shortage or accident. During 1924 it was able to supply the Pacific Gas & Electric Co. with an average of 1,500 kw. for several months.

The boiler plant consists of 23 boilers, with a total rated capacity of 10,150 hp. The control of these is accomplished by the use of an automatic oil regulator, damper controllers and feed-water regulators. A CO_2 recorder and a soot blower have been installed for each boiler. The auxiliary plant consists of two 100 g.p.m. turbine-driven feed pumps, two horizontal steam-driven fuel oil pumps, two 1,000 g.p.m. motor-driven service pumps and two feed-water heaters, each with a capacity of 250,000 lb. water per hour, and two oil heaters, each of 600 sq.ft. heating surface. A feed-water treatment plant has been provided, and each set of two boilers is connected with a fuel economizer.

Mention has already been made of the attention paid at the Crockett refinery to neatness and cleanliness, as

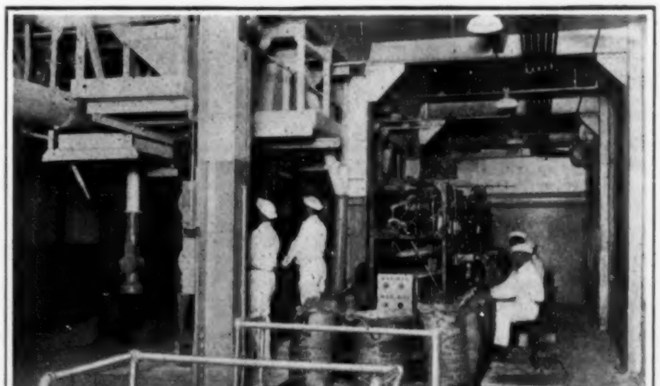


Fig. 14—Machine for Filling Sugar Bags

Bags are filled by delivery from an automatic weighing device, and are then sewn, a check on weight being made by the provision of colored lights, which flash in synchronism with the operation of the weigher.

essential prerequisites to smooth operation and the avoidance of waste. In every department, even where bone char is handled, it would seem to the casual arrival that a visitor of critical observation had been expected; but as a matter of fact the record of impressions gained during three visits, several months apart, indicate that order is the rule, to which all employees must subscribe. This fine influence is carried, insensibly, into the township. An intensive study of the factors affecting industrial relations has been and is being made by company officials, in an effort to remove discontent in any form, and to insure the co-operation and mutual regard that exist in the plant, is evidenced by a low labor turnover.

Fundamental relations between employer and employee must be on a sound basis before any move that savors of paternalism will be tolerated by the average wage earner. At Crockett the favorable response to company overtures is an evidence of the adoption of engineering common sense in matters relating to welfare work.

Fig. 15—Method of Filling Sugar Barrels
Barrels being filled with sugar are given a continuous jarring by being placed on a jigglor during the operation, this serving to settle the product and thus insuring full weight in the barrels

The company builds attractive and comfortable homes, which employees can acquire at minimum cost by small payments at regular intervals. Fifteen gardeners are kept on the payroll, and nurseries are well stocked with plants for free distribution among employees and residents of the district. Parks have been laid out and playgrounds built; clubhouses for men and women are available. A modern hotel is provided, in which room and board can be obtained at a reasonable rate. Athletics are encouraged by the maintenance of a swimming pool, tennis courts and a gymnasium-auditorium. The company actively co-operates with the local school authorities, not only in assisting in general educational matters, but also in providing instructions and entertainment for the foreign American-in-the-making.

For the privilege of acquiring, through pleasant channels, the information and impressions that formed a foundation for the foregoing notes, technical and general, I am particularly indebted to George M. Rolph, general manager, A. M. Duperu, plant manager, C. L. Carlson, assistant chief engineer, W. P. Bell of the operating staff, and W. B. Tyler, assistant secretary. H. C. Wells is chief chemist, with A. A. Blowski as assistant.

European Efforts to Increase Ammonia Recovery

Various Methods Are Being Tried to Increase the Yield of Fertilizer From Coal Carbonization Processes

By C. H. S. Tupholme
London, England

THE increased interest now being taken in Europe in low and semi-low temperature distillation of coal is partly due to the efforts to produce cheaper ammonia. It is, of course, known that over 70 lb. of ammonium sulphate per ton of coal can be obtained in the Mond producer, and, by operating on semi-low temperature lines with the use of about 40 per cent excess steam, the ammonia yield can be greatly increased. The disadvantage here is, of course, that the normal process of gas manufacture and coking is interfered with. Not more than 20 per cent of the nitrogen available in coal is recovered as sulphate when the coal is carbonized by present methods. Aside from the usual losses occurring during operation of the plant, ammonia is lost because of the amount, around 16 to 20 per cent, of free nitrogen in the coal gas; while the remainder of the nitrogen, often over 60 per cent, is left in the coke. The occurrence of free nitrogen in coal gas means that the decomposition of ammonia already formed has occurred.

That it is possible to obtain the greatest part of the nitrogen remaining in the coke in the form of ammonia has been demonstrated by Cobb, though the process used is not available for a commercial scale plant. In spite of this the investigations conducted in this direction are of extreme importance to the carbonization industries. In this connection the work now being done by several British chemists on the means for increasing ammonia yields is likely to lead eventually to improvements in actual operation, the investigations taking into consideration, as they do, the conditions under which distillation is effected in gas works and coke oven plants, e.g., temperatures of carbonization, humidities, rates of gas flow, dilutions, effects of ash in coke, materials of retort construction and the catalytic effects of coke.

It has been demonstrated that oxidation is of less significance in ammonia dissociation than was supposed. Combustion of part of the hydrocarbons in the gas may give rise to overheating with the consequent dissociation of the ammonia into its constituents. Water vapor aids in limiting the destruction of the ammonia, due possibly to dilution and a quicker removal of the ammonia from the dissociating influence of temperature. It is found that such protection is progressive up to a water vapor content of 25 per cent when, under certain conditions, the ammonia is apparently completely protected.

Such an effect has been demonstrated in an experiment where oxygen was mixed with ammonia gas under controlled temperature conditions. It was found that the ammonia was stabilized, owing to the fact that the oxygen combined with the hydrogen present forming water which, as already explained, is ammonia-protective.

Another point under investigation in the European distillation industries is the effect of various surfaces on the dissociation of ammonia. It is known that coke

has some such effect, but catalytic action of surfaces has also been observed in the case of broken firebrick and various metallic oxides. For instance, Cobb has demonstrated experimentally that when gas from the distillation of coal is led through a tube packed with coke maintained at 800 deg. C. only 9 per cent of the available nitrogen is recovered as ammonia, against 22 per cent in straightforward carbonization. Firebrick retorts where deposition of active iron has taken place show heavy losses of ammonia, the firebrick acting as a catalyst. Silica brick has less effect. In any case, it has been well established that salty coals are deleterious where ammonia recovery is desired, because the salt assists the volatilization of ferrous materials, which are then deposited on the walls of the oven as oxide—a catalyst to be reckoned with.

Various points of practical application have been established as the result of recent research into the conditions of ammonia recovery in the carbonization industries. For instance, excessive temperatures are to be avoided; mechanical infiltration of air is injurious; damaged firebrick should be repaired, and, if possible, replaced with silica; ferric oxide in the construction of retorts and ovens is to be avoided; the ammonia-protective action of water vapor is worthy of serious attention. Finally, steaming is to be recommended. Especially is this to be recommended after the 20th hour in coke ovens, as it is found then to aid in stabilizing the ammonia.

Many unsuccessful attempts have been made to increase ammonia yield. For instance, Riedel proposed to add a hydrate which liberated its water of crystallization above 500 deg. C. and also such salts as calcium chloride, by which method he claimed that 80 per cent of the nitrogen of the coal was recovered as ammonium chloride. Christensen, again, added silica and salt to the coal charge with the object of volatilizing the chloride of ammonia to a high yield. Nothing further seems to have been done along these lines, but they do seem to be suggestive. Another direction in which investigation is proceeding is the working up of the ammonia liquor, because it is realized that if a more concentrated liquor can be evolved the distillation costs per ton of ammonia will be lessened. Another line of study is the provision of ammonia stills of higher efficiency than those generally available.

German chemists, because of the high cost of sulphuric acid in that country, are recommending the production of ammonium bicarbonate instead of sulphate in the carbonization industries. This can be manufactured in the ordinary gas plant, but it seems that the synthetic ammonia plant is in just as favorable a position to undertake the production of this salt, because the synthetic plant produces large amounts of carbon dioxide as a byproduct of hydrogen manufacture. In the process a current of carbon dioxide is passed for about 10 hours through a vessel containing 20 per cent ammonia liquor. The ammonia carried off is trapped in an acid pot, and the ammonium bicarbonate which separates out is recovered by centrifuging. This ammonium bicarbonate is, from some points of view, not as good as sulphate, while in other respects it is superior. It loses by volatilization, but if dry and suitably packed the loss is found not to exceed 0.5 per cent in 30 days, the greater part of this loss being carbon dioxide. As far as application to the soil is concerned, it will be remembered that the sulphate salt has the tendency to diminish calcium in the soil by the formation of an insoluble calcium sulphate: on the other hand the decomposition of the bicarbonate yields only ammonia and carbon dioxide, which gas is, if it can be said to have any effect, more beneficial than otherwise to crops.

Urea, containing 45 per cent available nitrogen, is also proving attractive to the manufacturer of fertilizers, especially where sulphuric acid is costly. The fixing agent here is carbon dioxide, ammonium carbonate being formed and subsequently converted into urea. The two gases combine easily, the carbamate being briquetted and heated in autoclaves to 150 deg. C. A conversion of 40 per cent is attainable, and the carbamate remaining is distilled off in a stream of carbon dioxide. This process is not yet applied to commercial scale operations, though the experiments have been carried out under conditions which would seem to promise success in larger plants. Whether the production of urea in the carbonization industries will materialize is impossible to say, but there is no doubt that the fixing of ammonia in the form of urea has many attractions. A new method of urea production is therefore of interest, since it eliminates some of the difficulties in the method described above. In the latter method the scraping of condensers and high pressure autoclave treatment is unnecessary.

Mixter observed the direct formation of urea when ammonia and carbon dioxide were passed through a red hot tube, and later, Werner suggested the use of catalysts to increase the yield. A modern investigator, Bailey, has gone further and shown that thoria acts as a dehydrating agent in the reaction and increases the yield of urea from the two gases from 14 to 19 per cent. If the water is removed from the gases after the reaction and the latter re-circulated through the heated tube, as much as 50 per cent of the carbon dioxide can be converted into urea, provided that the ammonia is always in excess. The apparatus used by Bailey was a quartz tube fitted with a concentric cooled tube upon which the urea condensed. Possibly the yield could be increased if longer tubes were used. This process is obviously not ripe for industrial application but it gives some indication of a catalytic process without the preliminary formation of ammonium carbamate—a troublesome factor.

Several practical considerations militate against the application of the process as it now stands, but it does point the way to a catalytic process. An efficient catalyst giving complete or almost complete conversion of ammonia and carbon dioxide in a single passage, without ammonia being present in excess, seems to be the remaining desideratum to render the process commercially practicable.

The manufacture of ammonium chloride is reported to be taking place on a large scale in Germany, where its value as a fertilizer is believed in. The manufacture of this salt combines well with that of soda by the Solvay process, and, if this salt became popular as a fertilizer, the production costs of synthetic ammonia fertilizer would be reduced to the minimum in Britain on account of the Brunner-Mond control over both the synthetic ammonia and soda-carbonate processes. Should urea, urea nitrate or phosphate, ammonium bicarbonate or ammonium chloride become adopted commercially as fertilizers, the synthetic plants will be placed at a distinct advantage on account of the ample supplies of the fixing agent required in each case, i.e., carbon dioxide.

Multiple-Effect Distillation of Ethyl Alcohol

New Application of a Well-Known Principle Promises Savings in Alcohol Production

By George Calingaert

Chemical Engineering Department Massachusetts Institute of Technology

ACCORDING to a recent article (*Chem. & Met.*, 1925, vol. 32, p. 122) 67,000,000 gal. of ethyl alcohol was produced in this country during 1924. A casual inspection of the distribution among the various consumers is indicative of the extreme importance of alcohol in our industrial life. Indeed, Tunison has remarked that one of the main reasons why the German chemical industry dominated in 1924 was favorable legislation that provided tax-free alcohol for industrial purposes. New applications of internal-combustion engines have increased greatly the demand for suitable fuels, and the possibility of using alcohol as a substitute for gasoline has been given careful thought.

Whether or not alcohol is to be the fuel of the future will not be discussed here. What is needed is an improvement in the technology of alcohol production, notably the efficient and economical concentration of alcohol by distillation. Although the method outlined here is new, as applied to the distillation of alcohol, the various principles underlying it have long been understood and have been applied independently in other industries.

Practically the entire production of ethyl alcohol is obtained by the fermentation of carbohydrates, such as sugar, starch, or cellulose. The resulting "mash" contains from 5 to 14 per cent of alcohol, that is separated by fractional distillation. This operation on plant scale was accomplished successfully by Barbet in France, about 1890, and his method, with only slight improvements is being used at present. A modern alcohol distilling plant comprises a beer still, which separates the alcohol, as a 35 per cent aqueous solution, from its non-volatile impurities and two rectifying stills, separating the alcohol from the light heads and from the water, giving a final product of 96 per cent alcohol by weight, this being the composition of the constant boiling point mixture under atmospheric pressure. Heat interchangers are provided whereby the sensible heat of the bottoms is used to heat the feed partly.

In a well designed plant, the minimum consumption of steam for distillation of alcohol from the mash to the 96 per cent final product is 35 lb. per gallon of alcohol, and is quite often much higher. On the other hand, the energy theoretically required to accomplish that process can be easily calculated, and is very much less.

An ideal reversible cycle of operations is schematized below:

Fig. 1

A Modern Alcohol Plant

This aerial view of the U. S. Industrial Alcohol Co. plant at Curtis Bay, Md., is indicative of the importance of the alcohol business. In many plants the cost of steam appears to be as high as 25 per cent of the total production cost, thus showing the opportunity for steam economy through the use of multiple-effect distillation. The principles of multiple-effect distillation have been long understood and are successfully applied to other industries.

$$\begin{array}{ccc}
\text{(a)} & & \text{(d)} \\
\text{Alcohol liquid} + \text{water liquid.} & \longleftarrow & \text{Water vapor alc. liq.} + H_2O \text{ liq.} \\
\uparrow & & \uparrow \\
\text{(b)} & & \text{(c)} \\
\text{Alcohol-water, liquid.} & \longrightarrow & \text{Alcohol-water, vapor}
\end{array}$$

According to the laws of thermodynamics, the energy required to perform a certain change is independent of the method used. Thus, the energy required to go from (*b*) to (*a*) directly is equal to that to go from (*b*) to (*a*) through (*c*) and (*d*). Neglecting the heat of mixing, which is small, the energy absorbed in the process is only that required to compress the vapors of alcohol and water separately from their partial pressures in the mixture to their saturation pressures. This is expressed as follows:

$$E = RT\ (x) \ln \frac{P_a}{p_a} + (1 - x)\frac{P_b}{p_b}$$

where:

R = the gas constant = 1.98 gm. cal., if E is expressed

in mechanical equivalents of gm. cal. per gm. mole of mixture. T = abs. temp.
(x), $(1 - x)$ = mole fractions of the two components A and B.
P_a, P_b, the saturation pressures of A and B at T,
p_a, p_b, there partial pressures in the mixture.

To separate 96 per cent alcohol from a 5 per cent mash requires, according to the foregoing formula, only the mechanical equivalent of 20 B.t.u. per lb. alcohol. If steam is to be used as a source of power, setting the efficiency of a heat engine at 25 per cent, this would correspond to 0.55 lb. steam per gal. of alcohol.

On this basis, the highest plant efficiency is only 1.5 per cent of the theoretical. Why the difference? No procedure is known by which a mixture of alcohol and water, either as vapor or as liquid, can be separated with only the low energy consumption required by the theory. Our best method of approximating this fractional distillation involves the temporary application of a quantity of energy to heat and vaporize the mixture. This heat is greatly in excess of that actually consumed to effect the separation, and it should be possible to recover most of it. This is done to a certain extent in the heat interchangers, but with every effect operating under the same pressure, the waste heat from one effect is never available at a temperature high enough to vaporize the liquid in another effect, and it can be used only to preheat the feed nearly to its B. P. The heat of vaporization is then again provided by outside heating, through the application of steam.

On the basis of the foregoing principles, the practical way of improving the efficiency of alcohol stills is obvious: In order that the "overflow" of heat of the first effect can be used in another effect, the latter must operate under a lower pressure, such that the vapor condensing from the first effect will be hot enough to vaporize the liquid in the second effect. This can be repeated again, if it is possible to operate a third effect, at a still lower pressure.

In the diagram effect A, heated with high pressure steam, operates under 30 lb. gage pressure, for instance. The vapors escaping at the top are condensed in closed

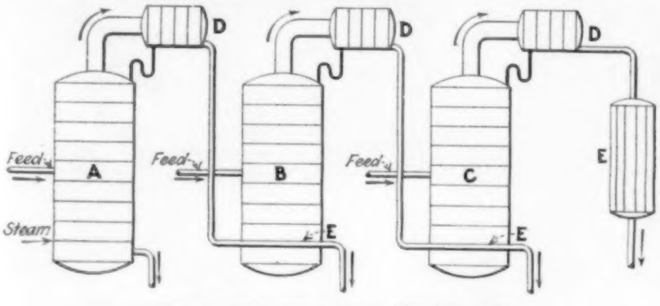


Fig. 3—Multiple-Effect Alcohol Still
The multiple effect still usually has three or four effects in series, separated by dephlegmators and terminated by a final condenser.

coils at the bottom of effect B, operating under atmospheric pressure. The heat given off by the vapor from A is thus sufficient to vaporize the liquid in B. Likewise, the vapors from B are used in C, operating under a lower pressure, say about 28" vacuum.

The operation of a fractionating column under low pressure involves the use of plates having a low pressure difference, that is, offering practically no liquid head to the ascending vapors. This feature has been attained in the Schneible still. The plates in this still have but half the efficiency of ordinary plates, or 25 per cent of the theoretical. This simply means that twice as many plates must be used to obtain the same degree of separation. The specific operation to be performed by each effect is somewhat independent of the fact that multiple effect is used. All three effects could, for instance, be used to prepare concentrated alcohol from the same feed, or each one could function

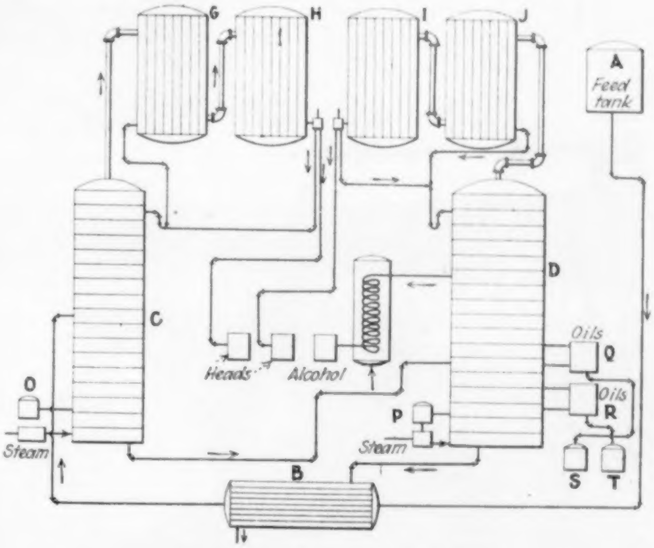


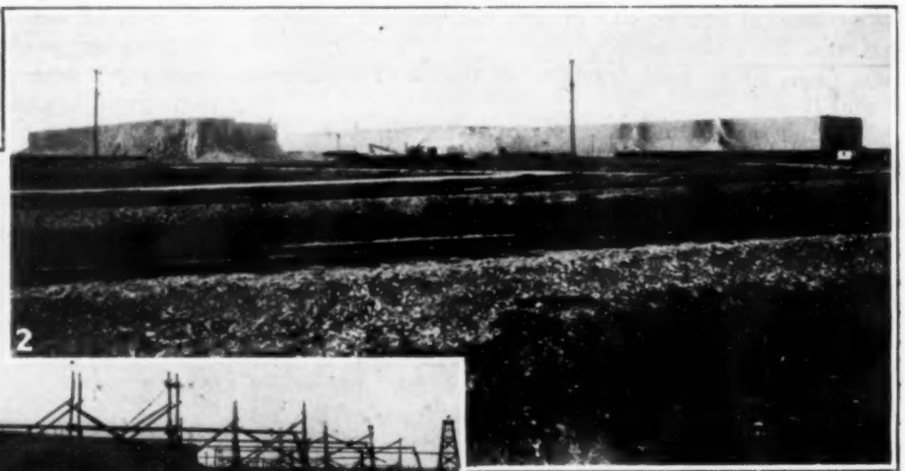
Fig. 2—Continuous Alcohol Still
The modern distilling plant comprises a beer still, two rectifying stills and heat exchangers to preheat the feed liquor. (From C. S. Robinson, "Elements Fractional Distillation," p. 147.)

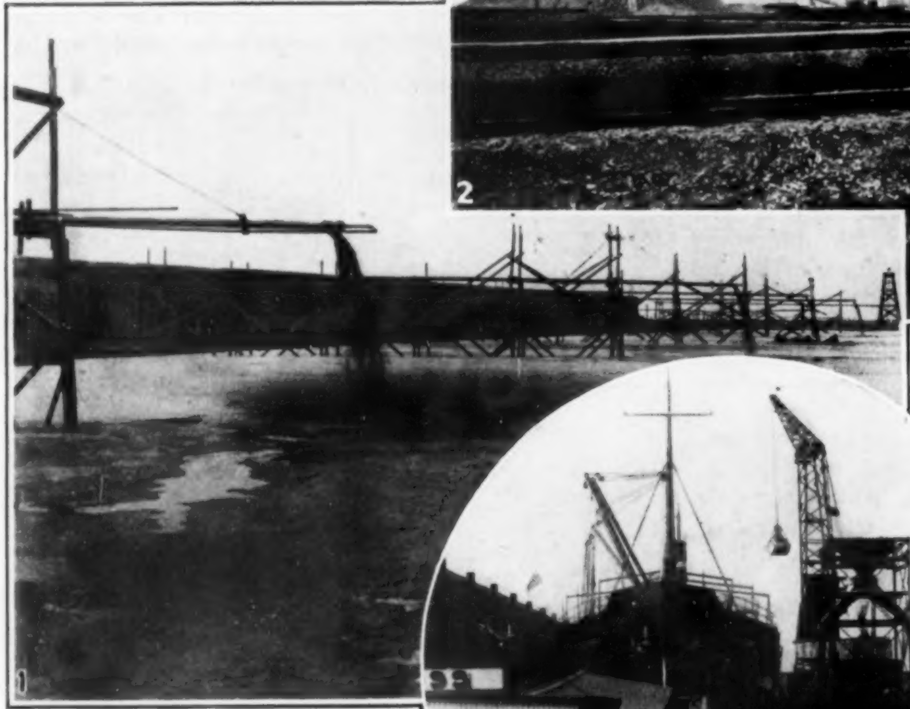
as a section to perform only one step of the separation, the product of one effect being fractionated further in the succeeding ones.

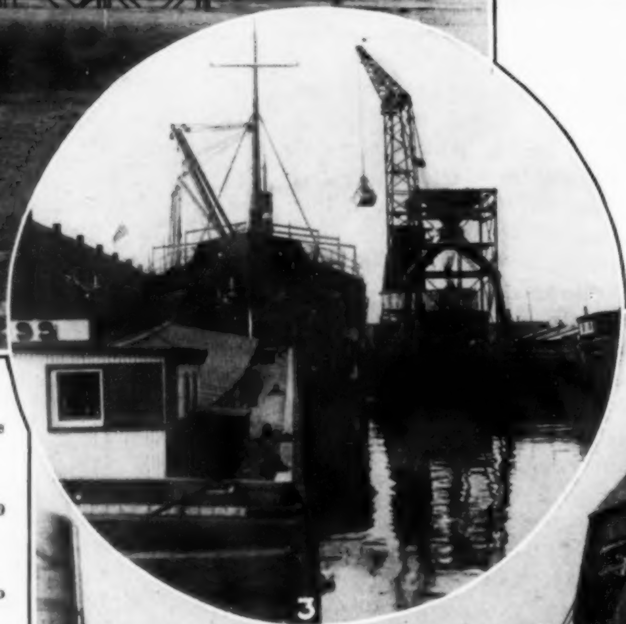
Assuming that heat interchangers can be used to preheat the feeds, the total steam consumption will be reduced in proportion to the number of steps in the multiple effect distillation. Probably it would not prove economical to use more than 4 or less than 3 steps, thus reducing the total steam consumption to one-fourth or one-third of that in the present type of single effect stills.

Two additional advantages of this method are: (1) The factor limiting the capacity of a still is the linear velocity of the vapor. Effect A, operating under high pressure, will have a correspondingly high capacity, in pounds of alcohol at any given linear velocity of vapor, thus reducing the fixed charges on the investment in equipment per lb. of product. (2) The fractionation under atmospheric pressure of alcohol-water mixtures containing less than 96 per cent alcohol by weight, never yields a product higher than alcohol, this being the constant B. P. mixture. When it is desired to obtain absolute alcohol, more expensive chemical methods must be used. But under pressures below 70 mm. of mercury there is no constant B. P. mixture, and 100 per cent alcohol can be obtained by distillation. In practice, 98 per cent alcohol is obtained in a good vacuum still, and this can then be refractionated under atmospheric or some higher pressure, to yield about 50 per cent of absolute alcohol, and 50 per cent of ordinary 96 per cent alcohol.

With steam at 60c. per 1,000 lb. and under the best observed conditions, the present method takes 35 lb. of steam per gal. of product, the steam cost being 2c. per gal. or about 10 per cent of the total cost of the alcohol. In many plants the cost of steam appears to be as high as 25 per cent of the total production cost.







A Great Raw Material Goes To Market

Fig. 1

Discharging molten sulphur into the storage vats.

Fig. 2

Solid blocks of sulphur more than 50 ft. high and covering several acres.

Fig. 3

S.S. Peter Crowell unloading its cargo of sulphur at the port of New York

Fig. 4

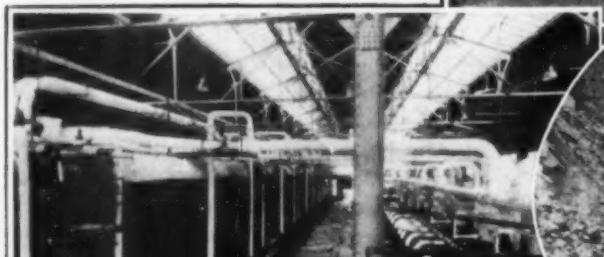
Loading sulphur onto a steamer at the rate of 600 tons per hour. The pier is that of the Texas Gulf Sulphur Co. at Galveston, Texas.

Fig. 5

Ten thousand boiler horsepower are generated here for superheating the water used in melting sulphur underground

Fig. 6

Side of the solid sulphur block broken down for loading into box cars



Sulphur, An Industrial Necessity

The Mysterious Reagent of the Medieval Alchemist Has Become the Keystone of Modern Industry, Touching on Practically Every Phase of Our Existence

By Henry C. Lint
Texas Gulf Sulphur Co., New York City

BECAUSE of its frequent occurrence in those countries that served as the cradle of ancient civilization, it is reasonable to believe that some knowledge of sulphur and its properties antedates the earliest records extant. Certain it is that applications of the medicinal and fumigating properties of sulphur were being made one thousand years before the Christian era. Pliny writing in the first century mentions the sulphur vendors of his time, and the fact of sulphur being mined in the Mediterranean Islands and refined by fire. During the Middle Ages sulphur was one of the chief reagents of the alchemists, and the undeserved virtues attributed to it were encompassed only by the limits of their imagination.

Despite its use, however, from the earliest times, it was not until the middle of the eighteenth century, when sulphuric acid began to be manufactured on a commercial scale, that the consumption of sulphur assumed tonnage proportions. Not until the middle of the nineteenth century was as much as 100,000 tons used per year. By the end of the last century consumption figures were about one-half million tons per year. At the present time about 1,800,000 tons of sulphur are being consumed annually, with the greatest increases being the contribution of the past decade.

Within the past 25 years profound changes have taken place in the sources of supply as well as the actual tonnage consumption. Most notable of the changes in the sulphur production of the world has been the rise of America from a place of inconsequence to that of complete dominance. Prior to 1903 Sicily in conjunction with Italy exercised almost a monopoly of the sulphur business of the world. In that year, however, the American deposits in Louisiana became productive, thanks to the novel means of mining with hot water, conceived and perfected by Herman Frasch. The changes wrought by his important discovery, as it affected both the American and Sicilian production, are shown in Fig. 7. While other countries produce small amounts of sulphur, only Japan, ranking third in importance, has been included to form the total indicated.

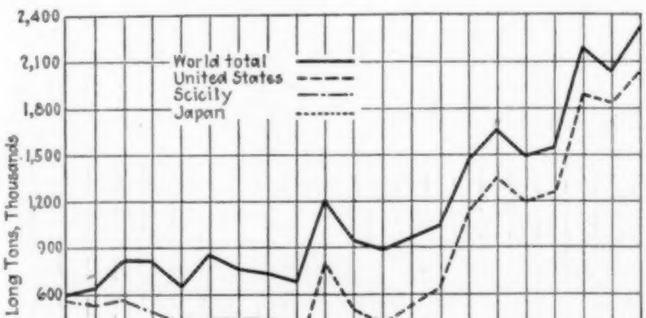


Fig. 7—World's Production of Sulphur

It is strikingly apparent that the rapid increase in American production is coincident with the world war. While sulphur has a most vital connection with the preparation of munitions, it is not to be understood that the war demands augmented the demand for sulphur to anything like the extent that the curve might indicate. Three interlocking conditions have conspired to cause American production to attain its large proportions, and also to remain so since the war.

Three Stimuli to Sulphur Production

The first has been the opening up of additional sulphur deposits. It is to be recalled that by virtue of its patent rights to the Frasch process the Union Sulphur Co. was for many years the sole American producer. In 1914 the Freeport Sulphur Co. began producing in quantity, and in 1919 the Texas Gulf Sulphur Co. started operations. With three producers rather than only one, the possibility of a larger output is at once apparent.

The second condition, that of increased consumption, is attributable to several factors. By very reason of the large visible reserves of sulphur above ground at the three producing mines the consuming industries were justified in expecting prompt and continued deliveries as never before. Somewhat out of a necessity enforced by the war conditions, the sulphuric-acid manufacturers in particular adopted sulphur as a raw material, thus increasing tremendously the consumption. Prior to the war large tonnages of pyrites were imported, particularly from Spain. Due to the shortage of vessels a curtailment of pyrites imports took place, and in consequence the acid plants were altered to permit the use of elemental sulphur. This latter material enjoys many points of advantage over pyrites, and as the result of the more efficient and satisfactory operation in using sulphur there has been but little return to pyrites.

The third factor, and in a measure the most important of the three, has been the low price of sulphur. It will be recalled that prior to 1896 most sulphuric acid was made from sulphur. As the result of a higher price for sulphur instituted by those in charge of the Sicilian mining operations, sulphuric acid manufacturers turned to iron pyrites as a cheaper raw material. Prior to the war American sulphur sold at $18 per ton at the mine, or $22 ex vessel at Atlantic Coast ports, a price somewhat too high successfully to compete with pyrites. During the war a price of $22 per ton at the mine was established by the Government, which, with high ocean freight rates, brought about a price of $30 to $32 on the Atlantic Coast. At the present time a price of $18 on the Atlantic Coast prevails. At this low price there are no economies to be effected by using any other raw material, thereby reverting in turn to the second condition of sulphur's recognized merits by acid producers, and likewise to the first, in that a suffi-

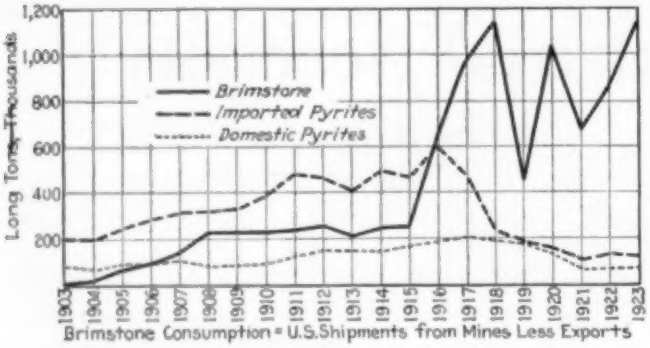


Fig. 8—Sulphur Consumed in the United States

cient tonnage is involved to justify three producers.

The influence of the increased use of sulphur on the imports and the domestic production of pyrites is shown in Fig. 8. Sulphur contained in the pyrites[1] rather than actual gross tons of these materials has been used, thus lending fairness to the comparisons. It is quite apparent that with only minor fluctuations there was a gradual increase in the consumption of sulphur prior to 1916, and that both imported and domestic pyrites followed the same general tendency as domestic sulphur up to that year. During 1916, however, sulphur consumption more than doubled, with further increases in 1917-18. During the same time imports of pyrites decreased 60 per cent. An additional falling off in the imports of pyrites rather than a recovery has characterized the post war years.

In addition to the marked influence on the pyrites consumption in the United States, American sulphur has had an equally important effect on the sulphur markets of the world. Prior to the opening of the Louisiana deposit, Sicily produced most of the world's sulphur, with the United States as one of the largest customers. In Fig. 9 the effect on the Sicilian exports both through the loss of our market and more recently by our competition in the world's markets, is shown.

As the result of American production, the market in this country for Sicilian sulphur dwindled from over 150,000 tons to less than 10,000 tons within the five years, 1903-1908, and it is interesting to note that the curve of Sicilian exports parallels that of our own imports, thereby reducing the total volume of their business by about 30 per cent. At the present time the American exports equal those made from Sicily in 1903 at the time when that country supplied the entire world. Sicilian exports for the seven years 1917-1923 are only about 44 per cent of their volume for the previous ten-year period.

Comparison between the sulphur consumption of the United States and the rest of the world serves further to impress the importance of sulphur in our industrial life. In 1903 the world consumption outside of the United States was equal to the Sicilian exports of 475,000 tons, less our imports of 155,000 tons or 320,000 tons. In 1924 the parallel condition is represented by the sum of the Sicilian and American exports, being equal to 700,000 tons. The net increase, therefore, of 380,000 tons is one of 119 per cent for the 20-yr. period. During the same period our own consumption has risen from the 155,000 tons of 1903 to over 1,055,000 tons in 1924, a net increase of 679 per cent.

From the viewpoint of mining industry, American sulphur production is radically different from any other type of solid mineral recovery, or even of sulphur itself as extracted in other parts of the world. To Herman Frasch, who originated the hot water process of mining sulphur, must be rendered the major credit for the position of this industry today. To conceive of melting sulphur hundreds of feet underground with hot water over 100 degrees above the boiling point, and then pumping the hot molten sulphur to the surface, was daring even to think. Through the physical problems which he solved, and the difficulties which he overcame, the otherwise worthless sulphur deposits of the Gulf Coast were transformed into a national asset. Since 1903, when commercial production really started, over 16,000,000 tons of sulphur of remarkable purity have been recovered. In 1923 over 2,000,000 tons were produced. Due in part at least, to the exhaustion of the Louisiana mine, production decreased to 1,220,000 tons in 1924, which is about 300,000 tons less than the quantity shipped. This is the first year since 1920, and the third since 1911, in which production has fallen below shipments. In any event American sulphur production assumes tonnage proportions never approximated in any other country at any time in the world's history. It shall be the further purpose of this article to indicate the industrial uses of sulphur that would call for such enormous output.

Sulphuric Acid the Largest Consumer

According to the latest available figures there were actually shipped from the American mines 1,537,400 long tons of sulphur in 1924. Of this quantity 481,814 tons were exported to foreign countries. By difference this country must accordingly have consumed 1,055,586 tons. Through what avenues this enormous total, sufficient to make a solid train of box cars over 200 miles long, finds usage, is interesting in the extreme. It is only when the function of sulphur in the industries is minutely analyzed that the opportunity for such large consumption is appreciated. By carrying the same investigation somewhat further we see not only justification for the present status, but additional possibilities that may tend even to increase the consumption.

From all points of view, sulphuric-acid manufacture is deserving of first place as a consumer of sulphur. Two raw materials are purchased for the production of sulphur dioxide, the initial step in the manufacture of the acid. The relative position of these two materials, sulphur and pyrites, has undergone entire reversal within very recent years. During the six years 1910 to 1915 inclusive, the consumption of pyrites averaged 1,300,000 tons per annum, equivalent to 585,000 tons of pure sulphur. Of this total about 75 per cent was imported, chiefly from Spain, the balance being of domestic origin. In 1923 the domestic production was 192,000 tons, or only 56 per cent of the previous average. Imports likewise were only 263,695 tons as compared

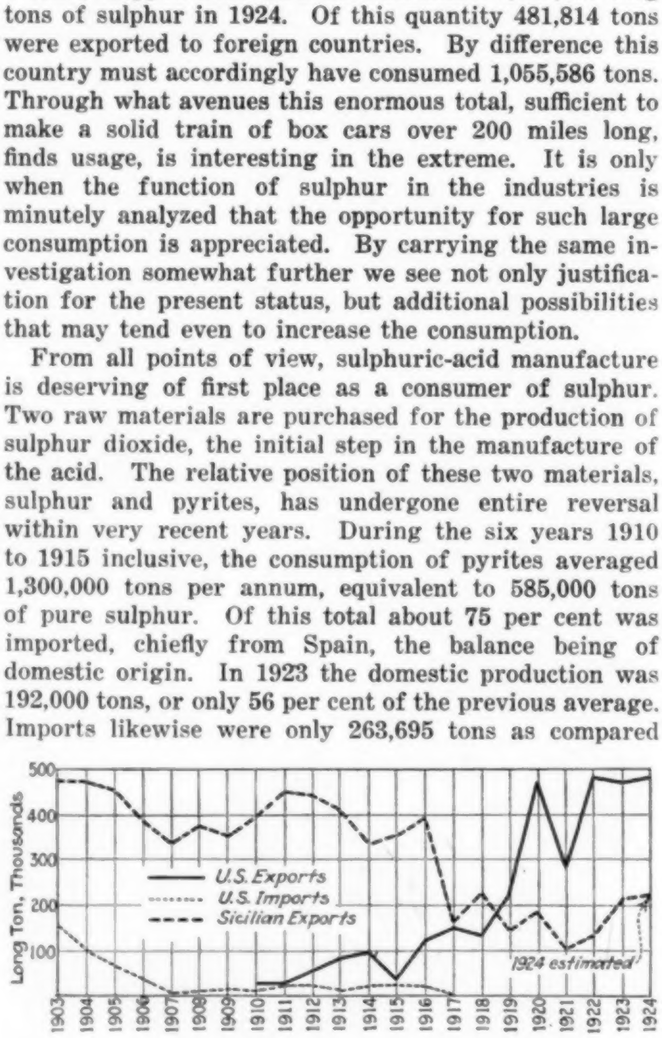


Fig. 9—Influence of American Sulphur on Sicilian Exports

[1]Mineral Industry data on domestic production and imports were used, calculated on the basis of 42 per cent sulphur in domestic pyrites, 48 per cent in imported pyrites.

with 935,810 tons for the six-year period, a net decline of 72 per cent. The decrease in the consumption of pyrites by 1,000,000 tons per year is practically the equivalent of 450,000 tons of sulphur, or over 2,000,000 tons to 50 deg. acid, so that simply to the extent that elemental sulphur has replaced pyrites in the manufacture of sulphuric acid, consumption figures immediately assume bold proportions.

Accurate statistics on sulphuric-acid production, particularly on the relative amounts made from sulphur, have been compiled only intermittently. By making use of such as are available, and computing those of the

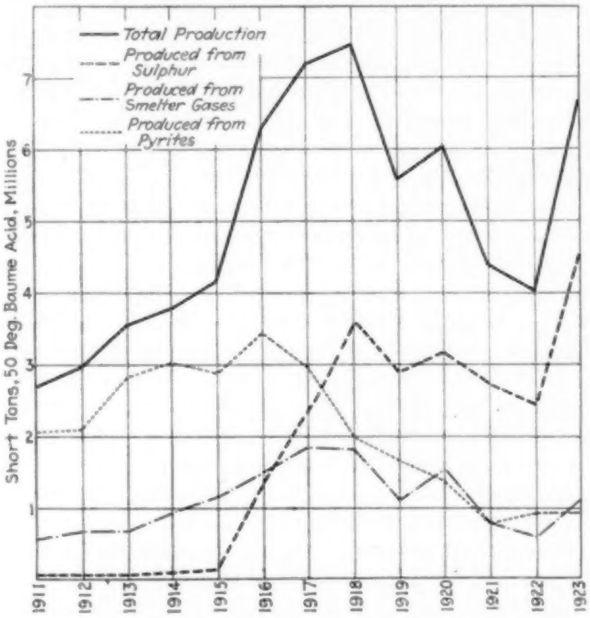


Fig. 10—Sulphuric Acid Production in Relation to Raw Materials Used

missing years on the basis of the raw materials consumed, a fair analysis of the situation has been rendered possible. Certainly such slight inaccuracies as may be present in no way nullify the purport of the curves as they reflect the tendencies. In striking fashion is the phenomenal increase in the use of sulphur for acid manufacture depicted, and not only has a high average production since the war been maintained; but the proportion produced from sulphur has been steadily increasing.

In Fig. 11 a computation has been made of the amounts of acid possible of manufacture on the basis of amounts of pyrite reported as consumed each year, and also from sulphur. The quantities from smelter gases are necessarily the same in both Figs. 10 and 11. In determining the quantities of sulphur that could have been used for acid manufacture the exports were subtracted from the total shipments from the American mines, thereby giving a figure representing the total United States consumption. An additional subtraction of from 220,000 to 250,000 tons was then made as representing the domestic consumption for purposes other than acid manufacture. Almost by the process of elimination, therefore, has the tonnage figure for sulphur consumed in acid manufacture been derived. As might be anticipated the total acid over the period of years, computed from the raw materials consumed, checks within 1.25 per cent of that reported.

It is apparent that, particularly since sulphur has become the chief raw material, there has been a considerable carry-over from year to year. During the war years considerably more sulphur apparently was shipped to acid manufacturers than the actual production would have required. In 1919, however, the acid production runs sufficiently ahead of sulphur shipments as to equalize the previous accumulation. The manner in which the actual tonnages of acid manufactured from sulphur neutralize those possible, on the basis of sulphur shipments is indicated by the superimposition of the two curves in Fig. 12. Undoubtedly the fact that less than one-half the actual tons of material is involved in storing sulphur instead of pyrites has contributed toward making the divergencies indicated.

What Becomes of Sulphuric Acid?

Quantitative data on the uses of sulphuric acid are taken from the Second Annual Review number of *Chem. & Met.*, which covers the year 1924. The production there estimated is 6,180,000 tons of 50 deg. Bé. acid, which is a decrease of about 5 per cent over the preceding year. These uses, as well as the relative changes in the amounts consumed by various industries in 1918, 1923 and 1924 are shown in Fig. 14.

It is readily apparent that with a consumption of 1,800,000 tons of sulphuric acid, the fertilizer industry is the most important consumer. Sulphuric acid is used chiefly in treating raw rock phosphate in the production of superphosphate. It is used to a lesser extent in the treatment of leather scrap, in the manufacture of wet base goods, fish scrap, and other materials. It would appear, therefore, that as a single product, superphosphate manufacture utilizes about 30 per cent of all sulphuric acid, and consequently about 21 per cent of all the sulphur used in this country.

Data on the sulphuric acid used in oil refining show that consumption has about doubled since 1918. Both a larger total production, and the fact of a greater proportion of the crude oil being of Mexican and California origin, which requires a somewhat higher acid consumption, has undoubtedly contributed to bring about this increase. Sulphuric acid is used in the petroleum industry to improve the color and odor of oils. The lighter distillates, such as naphtha and gasoline, require from one to four pounds of acid per barrel. Depending upon the color desired in lubricating oils the acid requirement will vary from 20 to 60 pounds per barrel, the more acid used the lighter the color obtained.

In the strictly chemical field, which is the one popular conception might regard as most important from the sulphuric acid standpoint, it is estimated that 1,000,000 tons were used. If this figure errs, it is on the side of conservatism, covering as it does, such an important product as sulphate of ammonia. The sulphate of ammonia produced in 1923, which is the last figure available, would have utilized 700,000 tons of 50 deg. acid. Practically all other acids are made commercially by the treatment of their salts with sulphuric acid. On the basis of their 1919 production the nitric and hydrochloric acid output of the country would require the use of about 280,000 tons of 50 deg. sulphuric acid. The dyestuff and artificial silk industries, which have developed so extensively in this country since 1915, utilize considerable quantities of sulphuric acid.

Nothing in the physical properties of tin or galvanized wares would suggest a necessity for sulphuric acid in their manufacture. However, it is estimated that 600,000 tons of sulphuric acid were used for steel pickling purposes. All rolled steel plate and wire carries

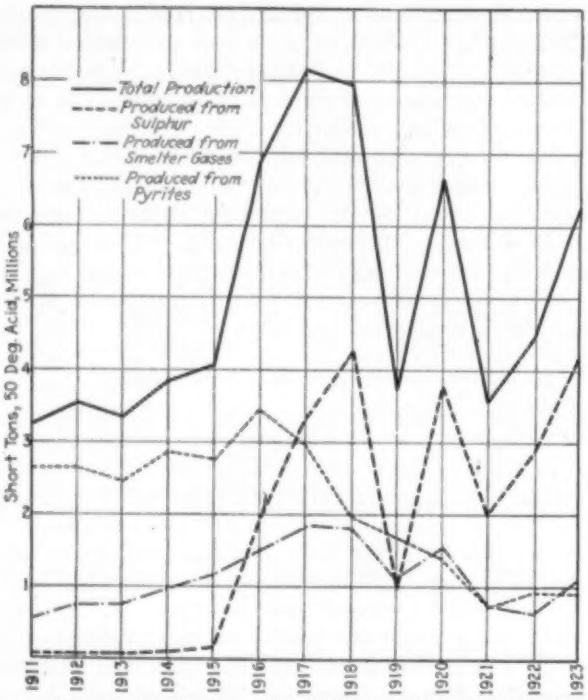


Fig. 11—Possible Production of Sulphuric Acid from the Different Raw Materials Had They Been Entirely Consumed

a thin scale or crust of oxide, which must be removed before the plating of tin, or of zinc in the case of galvanizing, will adhere. This cleaning is accomplished with dilute sulphuric or hydrochloric acid.

In a measure the fate in store for most sulphuric acid seems prosaic. Not so, however, with the 12,000 tons which are assigned to a life of "joy-riding" in the battery cases of automobiles. It will be readily appreciated that the automobile battery accounts for only a small portion of the 600,000 tons consumed in metallurgical and allied industries. How great may be the storage battery requirements with their enormous utilization in radio and in railway coaches, automobiles and lighting systems, is difficult of estimation. In 1923 about 143,000 tons of lead were used in the manufacture of storage batteries, and on the basis of the proportion of acid to lead being about one to ten, it is safe to assume that the equivalent of 15,000 tons of 50 deg. sulphuric acid were consumed in the battery industry.

The more strictly metallurgical uses of sulphuric acid are numerous. Perhaps the greatest use from the tonnage standpoint is as the electrolyte for the production of electrolytic copper. For the year 1923 it means that 651,000 tons of copper were dissolved by and in turn deposited out of sulphuric acid. One of the byproducts of the copper industry is copper sulphate or blue vitriol. It is used in the preparation of agricultural sprays for the control of plant diseases. While it is not entirely correct to ascribe all blue vitriol production to the interaction of copper and sulphuric acid, it is nevertheless of interest to note that it would require 20,000 tons of 50 deg. sulphuric acid to turn out the average production of 18,000 tons of blue vitriol.

A consumption of 200,000 tons of sulphuric acid is allotted to the paint and pigment industry. With the multitude of products here included it would be quite impossible accurately to apportion this tonnage among the products. Probably the most important of the paint materials calling for the use of sulphuric acid is lithophone. Over 36,000 tons of 50 deg. acid would be consumed to furnish the zinc sulphate required in making this product. Sulphuric acid is required in making the acetic acid used in the preparation of white lead. Some of the larger paint manufacturers now make calcium arsenate, the poison used most extensively in the control of cotton boll weevil. The nitric acid required for the preparation of calcium arsenate is in turn made from sulphuric acid. This illustrates the widely diversified activities coming within the scope of the paint manufacturer and is cited merely to show how reasonable may be the figures on total consumption within this industry, despite the fact that the final strictly paint and pigment materials would seem to fail to account for the acid employed.

The importance of sulphuric acid to the explosive industry was greatly emphasized during the recent war. As a dehydrater it is used in mixture with nitric acid in the manufacture of the nitro explosives. The two products of this class used under peace time conditions are nitro-glycerine and nitro-cellulose.

In the course of the manufacture of these high explosives by far the greater portion of the sulphuric acid is recovered, concentrated, and again used. Only the losses, therefore, appear as quantities consumed by this industry. In 1923 134,000 tons of high explosives and 30,000 tons of permissible explosives were produced. For this purpose 200,000 tons of acid were used, which conforms to the ratio shown in the Census Report of 1919. No data on explosives for 1924 are available, but the reports of conditions within the industry would tend to confirm the estimate of 180,000 tons for the sulphuric acid consumption.

It is quite unnecessary to list the various uses of sulphuric acid in the textile and fabric finishing industries in order readily to appreciate how as much as 100,000 tons could be employed.

The relative importance of sulphuric acid manufacture to the entire sulphur industry is shown in Fig. 13. Of the 1,250,000 tons of sulphur consumed in the United States and Canada in 1923 about 885,000 tons or 70 per cent were used by the acid industry; 270,000 tons or 21 per cent were used in the manufacture of sulphite pulp by the paper industry. Other of the minor uses later to be taken up are likewise indicated in Fig. 13.

The chief office of sulphur in paper making is in the

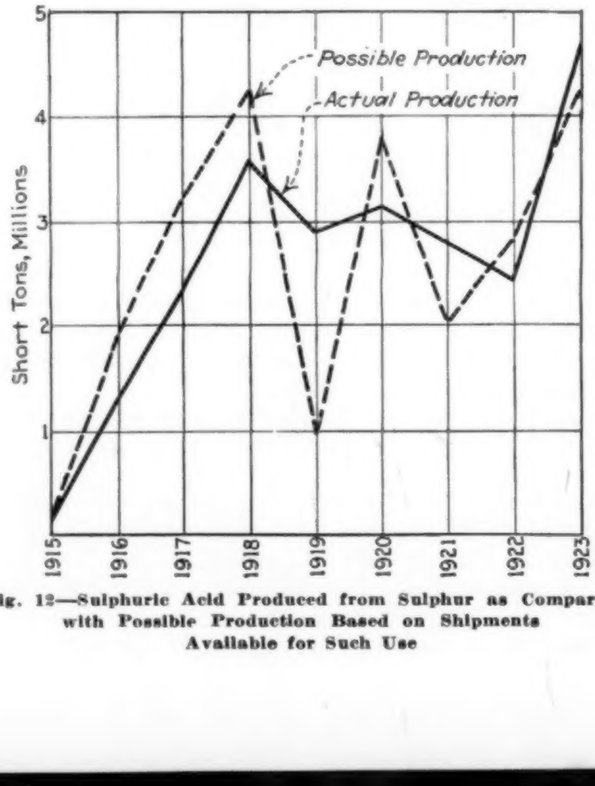


Fig. 12—Sulphuric Acid Produced from Sulphur as Compared with Possible Production Based on Shipments Available for Such Use

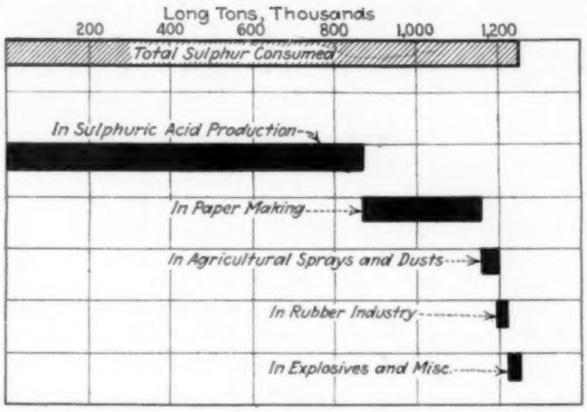


Fig. 13—Distribution of Sulphur Consumed in the United States and Canada in 1923

production of sulphite pulp. For this purpose sulphur is burned to sulphur dioxide, which, after cooling, is absorbed in a magnesia-lime solution (dolomite), forming the sulphites of these two metals. The amounts of sulphur consumed in sulphite pulp manufacture in both the United States and Canada are shown in Fig. 15. Sulphur consumption in long tons has been obtained by dividing tons of sulphite pulp by 8, which is equivalent to 280 lb. of sulphur per ton of pulp.

Over two million tons of sulphite pulp are used in the paper produced in the United States each year. From data presented in a recent Government bulletin[2] it has been computed that the distribution for the various grades of paper is as shown in the following table. The total consumption for 1922 of 2,066,000 tons of sulphite pulp has been divided on that basis, and in turn the relation of each grade of paper to the sulphur industry.

To a lesser extent sulphur in the form of sodium sulphate, a byproduct from the interaction of common salt and sulphuric acid in the production of hydrochloric acid, is used in paper making. The fibers thus pro-

[2]U. S. Dept. of Agri. Bulletin 1241, p. 12.

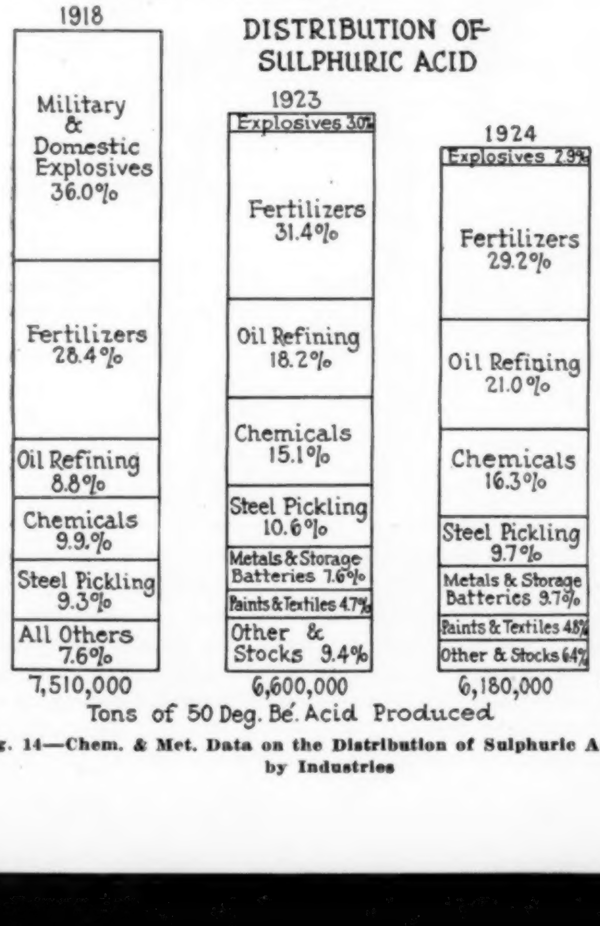


Fig. 14—Chem. & Met. Data on the Distribution of Sulphuric Acid by Industries

Kind of Paper	Per Cent of All Sulphite Pulp Used	Tons of Sulphite Pulp Used	Tons of Sulphur Used
Newsprint	28.319	585,070	73,134
Book paper	16.784	346,757	43,345
Boards	9.959	205,753	25,719
Wrapping	15.302	316,139	39,517
Fine	6.172	127,514	15,939
All other	23.464	484,767	60,596
	100.000	2,066,000	258,250

duced and known as kraft or sulphate pulp are especially strong, and are used in largest quantities in wrapping papers. In terms of the sulphur necessary to make the sulphuric acid used to make the salt cake, the

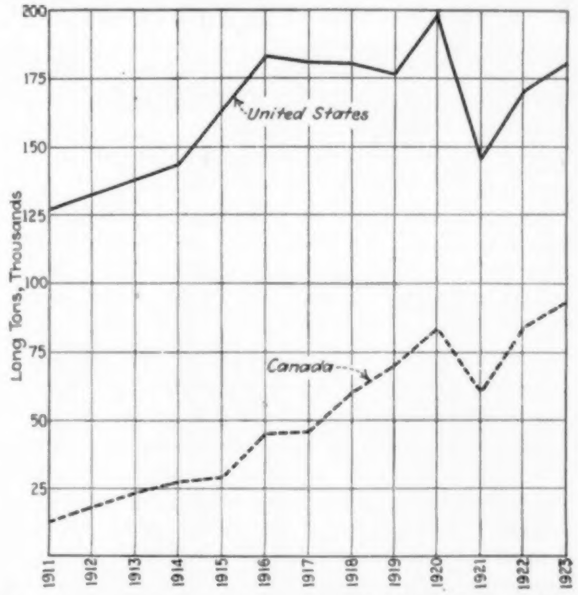


Fig. 15—Consumption of Sulphur for Sulphite Pulp Production in the United States and Canada

present production of 574,000 tons of sulphate pulp would require 23,100 tons of sulphur.[3]

While the office of sulphur in many other industries is well known, and is extremely essential in most instances, it is well to bear in mind that these miscellaneous uses collectively take less than one third as much as the paper industry, or only about 7.5 per cent of the total sulphur consumed. One of the chief of these minor outlets for sulphur is the rubber industry. Taking the average quantity of sulphur used per 100 lb. of crude rubber imported it would appear that from 20,000 to 24,000 tons of sulphur are used in the rubber industries.

Other minor uses of sulphur are, as an ingredient of black powder, requiring about 12,000 tons per year, and in the various agricultural sprays and dusts. Consumption in the latter class will vary as seasonal conditions favor the development of insect pests and plant diseases; but 20,000 to 30,000 tons per year fairly represents the limits of its utilization for such purposes.

Sulphur through its fertilizer relation has direct bearing on both food and clothing. Paper, produced with sulphur, is vital to an educated population, and is the medium of modern business transaction. Automobiles, the means of transportation characteristic of the age, have relation to sulphur through their batteries, plated parts, tires, and treated oils. A roll of film, a product of sulphuric acid, is fundamental in motion pictures. Thus has sulphur, the wonderful "burning-stone" of the ancients, and mysterious reagent of the alchemist, become the keystone of modern industry.

[3]Basis 500 lb. of $Na_2SO_4.7\,H_2O$ per ton of sulphate pulp.

Heat Transmission in Jacketed Kettles

A Comparative Study of Over-all Coefficients of Heat Transmission in Cast-iron, Lead-lined and Copper Steam-jacketed Kettles

By H. L. Olin, B. S. Southwick and H. M. Prince
Department of Chemistry, State University of Iowa

AMONG the most important variables in heat flow problems are (1) the material of construction, (2) the condition of the heating surfaces, (3) the density and the viscosity of the solution to be evaporated, (4) the temperature gradient, and (5) the velocity of convection currents. In general, the rate of natural convection is a function of the rate of heat flow and therefore of the temperature gradient. As in the earlier work (*Chem. & Met.*, 1924, vol. 31, p. 116) measurements are in terms of over-all rather than of film coefficients, for reasons to be discussed later.

To provide figures when acid solutions are to be concentrated, a series of tests on a lead-lined cast-iron kettle was made. The kettle had walls one-half inch thick, and had a mean over-all coefficient of 258 over temperature gradients ranging from 50 to 78 deg. F. A welded sheet lead lining one-eighth inch in thickness was hammered into place with a block and mallet. Because of marked inequalities on the inner surface of the kettle the job of fitting the lead was difficult.

As might be anticipated, the lining reduced the normal heat transfer of the kettle to a large extent and relatively high steam pressures were required to maintain boiling. However, this is an extreme case and higher conductivities are to be expected in apparatus in which the lead lining is more closely joined to the iron or steel shell. The complexity of the system of boundaries separating the heating medium from the liquid films is obvious. In addition to the two metal walls of cast iron and lead having actual conductivities of 864 and 1,920 respectively, there are three gas or liquid films to offer resistance to heat flow with the result that the transmission coefficient is reduced to 20 per cent of that of the unlined kettle. The air film between the lead and the iron, while relatively thin, has on the other hand specific conductivity of only 0.0005 that of the cast iron and this accounts for the poor showing of the apparatus. The results are interesting mainly for the light thrown on the effect of even a thin air film in series with good conductors, although in experimental plant work it is sometimes justifiable to convert an iron kettle into one that will resist an acid solution. For purposes of comparison, measurements on a lead-lined pan of best modern construction are to be made.

The curve obtained by plotting U against temperature gradient, as shown in Fig. 1, rises to a maximum at a difference of 65 deg., then falls to a minimum at 75 deg. We can explain these apparently anomalous results only by showing that the rate of convection flow, while low at best because of poor conductivity of the wall, increases slightly with increase in temperature gradient so that up to a certain point U increases in value as a result of the scouring action on the liquid film. With continued use, however, the lead lining gradually took on a thin coat of scale or other solid matter which apparently was a sufficiently good insulator to nullify the positive effect of the higher convection rate. This disturbing factor, noticeable at the time, was especially evident in later work with copper kettles.

TABLE I—TRANSMISSION COEFFICIENTS OF LEAD-LINED KETTLE—TIME OF RUN, 30 MIN.

Gage pressure Lb.	Temperature gradient Deg. F.	Water evaporated Lb.	Transmission coefficient U
15.0	38.3	10.25	51.5
19.8	47.0	12.50	51.4
24.6	55.0	17.00	59.3
25.0	55.5	15.50	58.1
25.0	55.5	15.00	56.4
29.9	62.7	18.25	60.8
30.2	62.9	16.25	53.7
30.1	62.9	16.25	53.8
35.0	69.3	16.75	50.4
39.8	75.1	19.75	54.7
40.0	75.4	18.50	51.0

In continuing this work a jacketed copper kettle of 35 gal. capacity, made of one-eighth inch copper, was used. Except for minor details, methods of operation were the same as before. A general view of the apparatus is shown in Fig. 2. At the beginning of this series of experiments two characteristics soon became evident; first, that heat transmission was so rapid as to make high steam pressures unnecessary and second, that the temperature gradient exercised a marked influence on the coefficient. Later it became apparent that the cleanness of the heating surface was a controlling factor of first rank. Table II shows the results obtained in the first series of runs with the heating surface covered with a film of oxide that had remained undisturbed since the time the pan was manufactured some years before.

TABLE II—TRANSMISSION COEFFICIENTS OF COPPER KETTLE SURFACE CONDITION, OXIDE FILM S_1

Gage pressure Lb.	Temperature gradient Deg. F.	Water evaporated Lb.	Coefficient U
10.0	28.0	46.00	695
10.0	27.8	45.25	699
10.0	27.3	48.00	735
15.1	38.4	88.50	985
15.0	38.2	78.00	886
14.9	38.1	79.50	906
15.1	38.4	91.00	1015
19.9	47.2	130.25	1170
25.1	55.6	163.50	1253

TABLE III—TRANSMISSION COEFFICIENTS OF COPPER KETTLE SURFACE CONDITION, OXIDE FILM S_2

Gage pressure Lb.	Temperature gradient Deg. F.	Water evaporated Lb.	Coefficient U
5.0	15.2	23.1	651
5.3	16.1	21.7	582
7.1	20.5	32.6	688
8.0	23.0	40.6	752
8.9	25.1	46.7	781
10.0	27.8	66.8	854
10.2	28.4	67.5	1036
10.7	29.4	72.3	1049

After the completion of this series of runs the pan which now showed considerable tarnish was cleaned with a dilute solution of nitric acid and left idle for several weeks. Table III shows the results as affected by this second oxidation film which although evidently thinner than the first was nevertheless decidedly positive in character.

In the next series the heating surface of the kettle

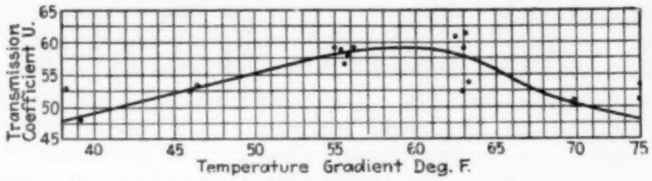


Fig. 1—Heat Transfer in Lead-lined Kettle; Coefficient of Heat Transmission U as a Function of Temperature Difference in Deg. F.

was kept as clean as possible with dilute nitric acid, followed by vigorous polishing. This unusual precaution was necessary if concordant results were to be obtained because of the rapid formation of the oxide film which seemed to possess surprising insulating properties.

TABLE IV—TRANSMISSION COEFFICIENTS OF COPPER KETTLE SURFACE CONDITION, CLEAN, S_2

Gage pressure Lb.	Temperature gradient Deg. F.	Water evaporated Lb.	Coefficient U
4.5	13.8	23.0	724
4.8	14.7	28.2	826
5.2	15.9	36.2	986
5.3	16.1	43.4	1161
5.8	17.4	62.4	1553
6.1	18.1	62.4	1503

To test further the blanketing effect of solid films the burnished copper surface was washed with a solution of sodium sulphide, forming a thin coat of black copper sulphide. Results given in Table V show that it was a better conductor than the oxide.

TABLE V—TRANSMISSION COEFFICIENTS OF COPPER KETTLE SURFACE CONDITION, SULPHIDE FILM, S_4

Gage pressure Lb.	Temperature gradient Deg. F.	Water evaporated Lb.	Coefficient U
5.3	16.0	26.1	707
6.9	20.2	43.0	924
8.9	25.2	65.6	1132
9.7	27.2	72.5	1149
10.4	28.8	77.5	1159

The marked effect of surface condition on heat transmission in a system of high conductivity is readily seen in Fig. 3 and the similarity of these curves to those of Pridgeon and Badger (*Ind. Eng. Chem.*, 1924, vol. 16, p. 468) with evaporator tubes of varying cleanness is evident. Any discussion of over-all coefficients for copper or similar heating surface that neglects this important factor is of limited application or of doubtful

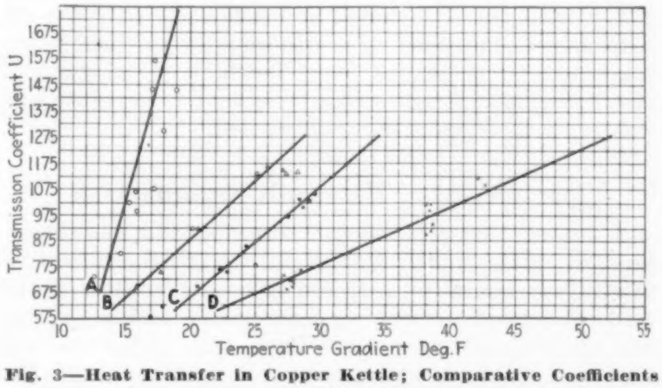


Fig. 3—Heat Transfer in Copper Kettle; Comparative Coefficients of Heat Transmission with Clean Copper Surface, Oxidized Surface and Sulphidized Surface

value, and in this class we must place many data proposed by Hausbrand in "Evaporating, Condensing and Cooling Apparatus." If we assume the apparent resistance of the oxide film to result from the maintenance of an abnormally thick liquid film on the surface rather than from any inherent insulating properties it may possess, we must recognize this relationship in formulating film coefficients. Another factor, (s), for character of the heating surface, should be included. This assumption seems justified in view of the thinness of these films which in some cases at least must approach molecular dimensions. Units, both qualitative and quantitative, to be used in measuring (s) are yet to be devised.

The question of how best to attack heat transfer problems, whether through over-all or film coefficient measurement, must be determined for the present at

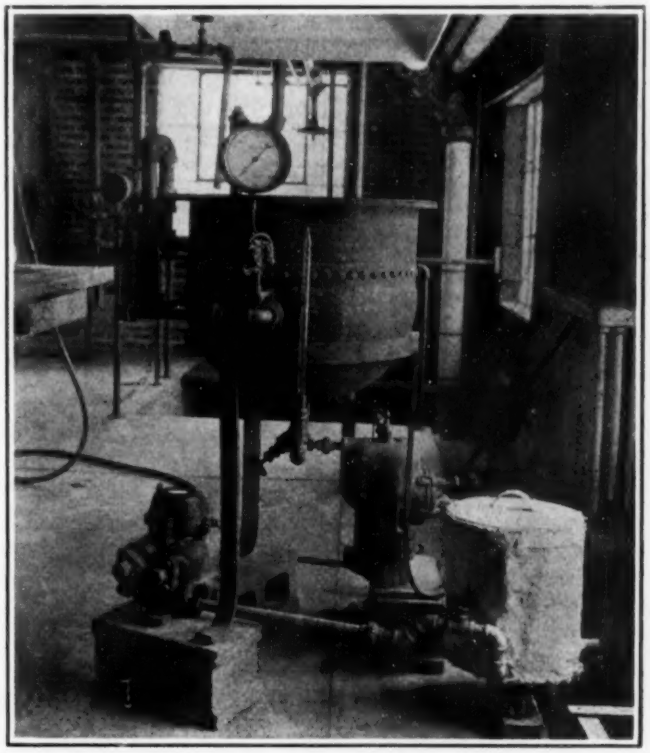


Fig. 2—Experimental Apparatus Steam-Jacketed Kettle for Measuring Over-All Coefficient of Heat Transmission from Condensing Steam to Boiling Liquid

least by the conditions of the case. McAdams and his co-workers (*Ind. Eng. Chem.*, 1922, vol. 14, p. 1101) have made valuable contributions to film data and advocate the use of the film method. For example, in the case of forced convection of liquids through pipes they propose the equation

$$h_L = \frac{cKv^nJ^n}{D^M} \tag{1}$$

wherein they relate the coefficient of the liquid film to heat conductivity, mass velocity, the fluidity of the liquid and to the pipe diameter. But when velocity is constant the problem is simple compared to one in which natural convection in boiling liquids, where rate of flow is a dependent variable. In the latter group are problems of evaporator heat transfer in general, whether convection manifests itself in the form of currents flowing through or around tubes as in the standard evaporator, film movement, as in the Kestner and the Lillie, or as turbulent circuits in the more simple kettles and pans. For general application in the design of heat exchange apparatus, the working formula must correlate film conductivity on the one hand with all the factors and conditions that affect it, namely, those in-

cluded in equation (1) together with others such as shape and condition of surface and the influence of natural convection. The latter particularly is a difficult problem of mathematical physics with which investigators have wrestled since the time of Fourier, among them being Lorenz (*Ann.*, 1879, vol. 7, p. 271) who found that in air convection the heat loss varied as $\theta^{\frac{5}{4}}$, Boussinesq (*Compt. Rend.*, 1901, vol. 133, p. 257), Russell (*Phil. Mag.*, 1910, vol. 20, p. 591), Davis (*Phil. Mag.*, 1920, vol. 40, p. 692), and Rice (*J. Am. Inst. Elec. Eng.*, 1923, vol. 42, p. 653). Work in this field involves the use of Fourier's equations for heat flow and the laws of hydrodynamics in so far as they have been formulated, and often the equations proposed are either unsolved or left with approximate solutions only. The complexity of the convection relationship may be seen from the Boussinesq formula as modified by Davis for viscous liquids wherein he expresses q_c = the heat loss by natural convection as a function of k the thermal conductivity, c = the heat capacity, μ = the viscosity and a = the coefficient of expansion of the liquid, and of θ the temperature gradient and g = the acceleration of gravity, thus:

$$(2) \qquad q_c = \frac{k\theta}{L} F\left(\frac{L^3\theta gac^2}{k}\right) f\left(\frac{c\mu}{k}\right)$$

Convection velocity depends upon the rate of heat loss, or

$$(3) \qquad v_c = f'(q_c)$$

It is evident, therefore, that the formula for film conductivity in free convection involves an equation analogous to (1) in which the independent variable v^m is replaced by an involved function of q_c as given in (2).

In attacking the problem of free convection from the standpoint of Langmuir's theory, Rice proposes the general equation for film thickness

$$(4) \qquad B = K\left(\frac{\mu}{\rho}\right)^m \frac{D^{\frac{2-3m}{2}}}{g^{\frac{m}{2}}}$$

where D is a linear dimension in terms of which all shape factors may be expressed, and the other terms have their usual significance. The substitution of B in Newton's fundamental equation for heat flow

$$(5) \qquad W = \frac{A}{B} Kdt$$

makes possible the solution of the problem of heat flow through the film. The shape of the heating surface, however, is a controlling factor and the equation must be modified for each special case. He further says that large areas involve many uncertainties, that a horizontal surface exposed upwards involves instability with the possibility of cyclonic action, but extended vertical surfaces will introduce draft effects that may require separate treatment. In evaporating pans and kettles both these conditions are satisfied.

In order to understand better the relation of convection to film thickness, take a system of heat exchange. If H is the over-all coefficient of the wall and the films, and θ_H the over-all temperature gradient, the total resistance to heat flow across a series of boundary walls is

$$(6) \qquad \frac{1}{H} = \frac{1}{h_1} + \frac{\lambda}{k} + \frac{1}{h_2}$$

where h_1 and h_2 are liquid and vapor film coefficients and k is the specific conductivity of the metal. Temperature drop across each separate film is proportional to its resistance and

$$(7) \qquad \theta_H = \theta_1 + \theta_2 + \theta_3$$

As the films are in series, heat flow is the same through each. When the total heat flow is measured and temperature drop across each film is determined by suitable instruments, the values of h_1 and h_2 may be calculated directly. These films are not uniform in thickness and resistance however; their conductivities depend upon certain characteristics of the liquid and of the surface to which they are attached and chiefly upon the mechanical effects of convection currents. Consider, in the simplest case a film of conductivity h_1, on an insulating surface s. This is separated from a wall of constant resistance R through which heat flows, by a liquid at a temperature corresponding to its boiling point t_2. Given a heating medium without the wall at the temperature t_1 we have $t_1 - t_2 = \theta_H$. Obviously the velocity of convection flow of the liquid will depend upon the rate of heat flow $\frac{Q}{t}$ and this in turn upon $\frac{\theta_H}{R}$. Expressed mathematically

$$(8) \qquad h_1 = f'(v_c) = f''\left(\frac{Q}{t}\right) = f'''\left(\frac{\theta_H}{R}\right)$$

But when the film forms part of the resistance of the wall through which heat transfer takes place, the relationship of h_1 to θ_H and R becomes much more complex—and this is true of heat flow through evaporator tubes and kettle walls. Indeed, in a nest of tubes, both cases apply, as the film on a given tube is affected by convection motivated by heat flow through an adjacent tube and film as well as by that passing the boundaries of the tube in question.

Caring for Paint Brushes

Paint and varnish brushes should be hung in a jar of kerosene if they are used only occasionally. This is the recommendation of the Bureau of Standards paint specialists. Of course these experts also recognize that the brush can be kept soft if suspended in linseed oil or turpentine, but these materials are much more expensive and are no better

The brush should be hung, not stood on its bristles, so that all of the bristle and about one inch above the bottom edge of the ferrule are covered with the liquid. The brush is then ready for use at any time on simply washing out with mineral spirits.

Of course if one wishes to store the brush for a long period it is best to brush out all of the paint possible, then wash it thoroughly with kerosene and finally either with mineral spirits or benzine, or with a good soap and water suds. When thoroughly dry after this treatment it can be put away indefinitely "as good as new." Varnish brushes should be kept in kerosene and washed with turpentine when needed.

Ore Dressing Research Summarized

A survey has been made of ore dressing nad metallurgical research in progress by the U. S. Bureau of Mines in co-operation with the milling committee of the A. I. M. E. and the mining departments of the University of California and of the Mass. Inst. of Technology. This revised summary has been issued as Serial No. 2,669 of the U. S. Bureau of Mines entitled "The Status of Research in Ore Dressing" by Ernest A. Hersam. Some of the sections are of interest to chemical engineers because they deal with crushing and grinding, separation, classification and flotation, concentration, de-watering, elutriation and other unit operations of chemical industry.

Making Pure Nitric Acid Economically

The Duriron-Hough Nitric Acid Plant Has Distinctly New Features of Design That Make Possible the Profitable Production of Small Quantities of Pure Acid

By A. Hough
Consulting Chemical Engineer

DISTINCT advances in the manufacture of nitric acid, especially in volume of production, were made prior to and during the War, but few if any improvements have been made since that time, as the enormous capacity of emergency plants erected for war purposes undoubtedly discouraged new construction. Recently, however, there has been a demand for small plants to satisfy economically the requirements of manufacturers using an appreciable quantity of nitric acid.

Appreciating these conditions, the Duriron-Hough plant was designed and a commercial size plant erected and operated for the purpose of developing a standardized unit plant. These standardized plants embody the improvements and modifications that naturally suggest themselves during the development of such a unit. As a result, the finally developed plant is a well-balanced, economical, easily-operated unit producing a maximum capacity. It is almost impossible to design and build a plant for a specific capacity and obtain satisfactory results without such progressive development work.

Where the point of consumption is located at some distance from an existing acid plant, nitric acid can be manufactured at a saving in cost over buying the acid, the principal saving, of course, being in freight, trucking and carboy expense. Manufacturers, however, as a rule have hesitated to build such plants, even though conversant with the savings to be effected, on account of the special nature of the equipment involved and the fact that they believe an experience acid man would be necessary to operate the plant successfully.

The few small isolated plants that have been built have, as a rule, been unsatisfactory. The small volume of the still in the old plants resulted in frequent priming of the contents into the condensers, which necessitated dismantling them frequently for cleaning. These small plants were often erected without due appreciation of the special problems involved, and this naturally resulted in only partially satisfactory operation.

The major difference between this and standard types of acid plant construction is a retort which is in the form of a horizontal cylinder. In order to obtain a uniform flow of gases from the still and to avoid the highly objectionable feature of priming, the still is constructed so that the charge of sodium nitrate and sulphuric acid is agitated continually, and the nitric vapors allowed to escape freely at a comparatively low temperature. Within the still are a number of perforated cast-iron disks mounted on a shaft extending through stuffing boxes in the end of the still and geared to revolve at a speed of 10 r.p.m. These disks provide the necessary agitation, and by raising a film of the sodium nitrate out of the charge, the nitric acid is volatilized from this film thus increasing the normal evaporating surface of the still several hundred per cent.

The still and disks are constructed of a close grained cast iron. The retort is mounted in a carefully designed brick setting so constructed that a controlled portion of the flue gases are bypassed around the cover to keep the temperature slightly above the condensing point of the gases. By means of proper temperature regulation the life of a still is greatly prolonged and the

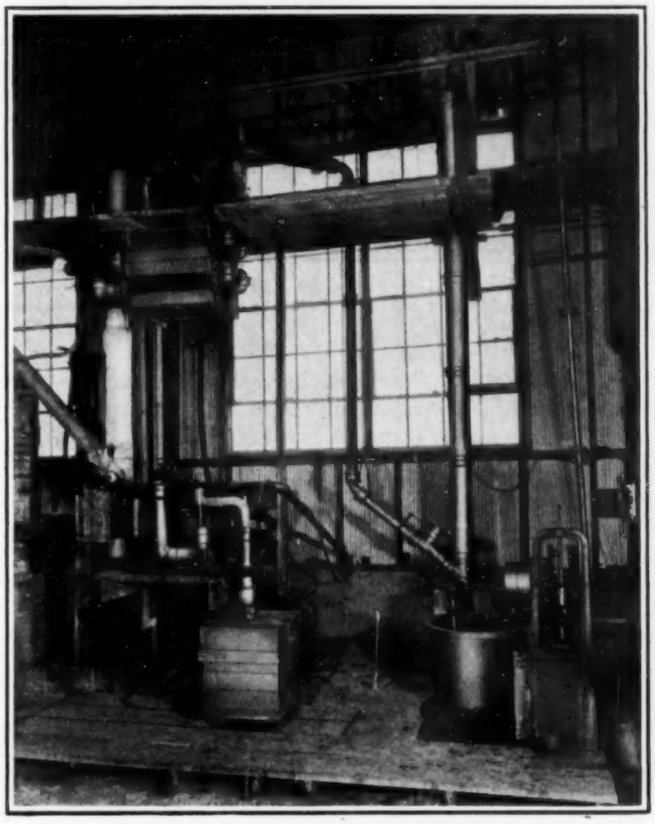


Fig. 1—General View of the Plant
With the exception of the still, the entire plant, including piping, bleacher, hyponitric tower pump and fan, is constructed of Duriron. Plants of larger sizes can be erected.

decomposition of the nitric vapors is prevented, resulting in lowering the proportion of nitrous gases, increasing the yield of strong nitric acid and decreasing the amount of weak acid recovered from the hyponitric tower.

A Duriron fume line carries the gases from the retort to the bleacher. In this line provision is made for admitting air through a 1-in. Duriron gate valve to provide oxygen to oxidize the lower oxides which may be formed in the film. The fume line and bleacher are insulated adequately to maintain a sufficiently high temperature in the bleacher thus giving complete bleaching and water-white acid. The bleacher consists of a Duriron base with a gas inlet and acid outlet and a section of standard Duriron pipe with a cover, through which the condensed nitric acid falls from the condenser

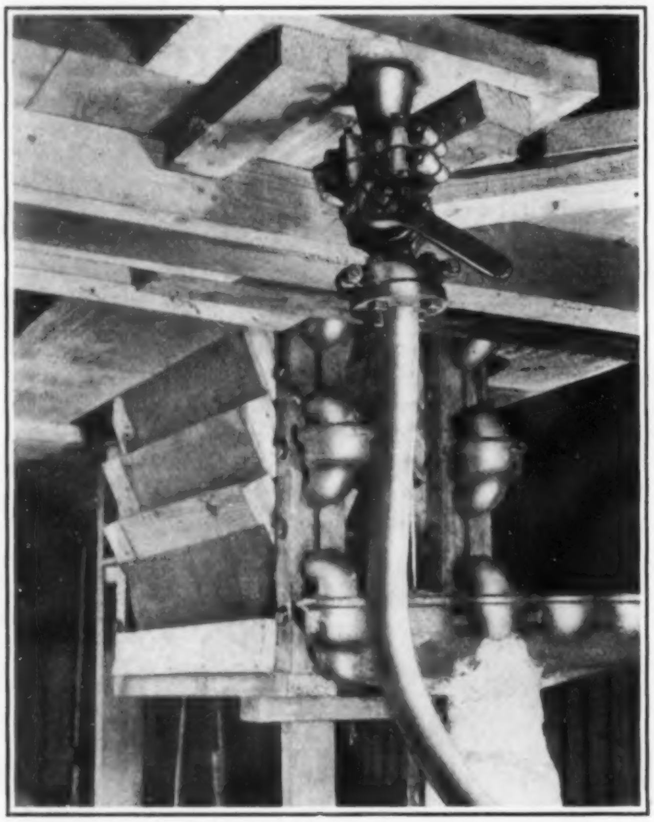


Fig. 2—The Acid Condenser
The condenser consists of two or more banks of 1½-in. Duriron S-bends together with the necessary manifolds and is located above the bleacher.

into the bleacher. The bleacher, suitably packed with chemical rings, functions by collecting the nitric acid and maintaining it at a temperature slightly below the boiling point by means of the sensible heat in the gases. At this temperature the lower oxides are practically insoluble and pass on to the hyponitric tower for oxidation and recovery. The bleacher is jacketed, so that it can be preheated before nitric vapors come over. This is an extremely important feature, as it makes possible the removal of the low oxides of nitrogen from the beginning of the run.

The condenser consists of two or more banks of 1½-in. Duriron S-bends, together with the necessary manifolds. The condenser is located immediately above the bleacher, and cooling is effected by an efficient method of water spraying. Such gases as pass through the condenser are drawn through a line to the hyponitric tower that consists, in the smaller sizes, of bell and spigot pipes with a base and cover provided with the necessary gas and acid openings The whole system is kept under reduced atmosphere pressure by a small motor-driven exhaust fan placed in the exhaust line from the hyponitric tower. Acid is circulated to the hyponitric tower by means of a belt-driven pump.

The acid produced is drawn off from the bottom of the bleacher and passed through a cooling coil, then through a hydrometer boot to the receivers or carboys. Provision is made by means of piping and flanges, to separate where desirable, the stronger parts of the run from the weaker acid. The strong acid may be run directly into carboys and the weaker acid either drawn off and used for blending the product or added to the weak acid recovered from the hyponitric tower for redistillation. Connections are provided so that the circulating pump of the hyponitric tower may also be used to pump the weak acid back into the still for redistillation. The strong acid is about 90 per cent of the total product.

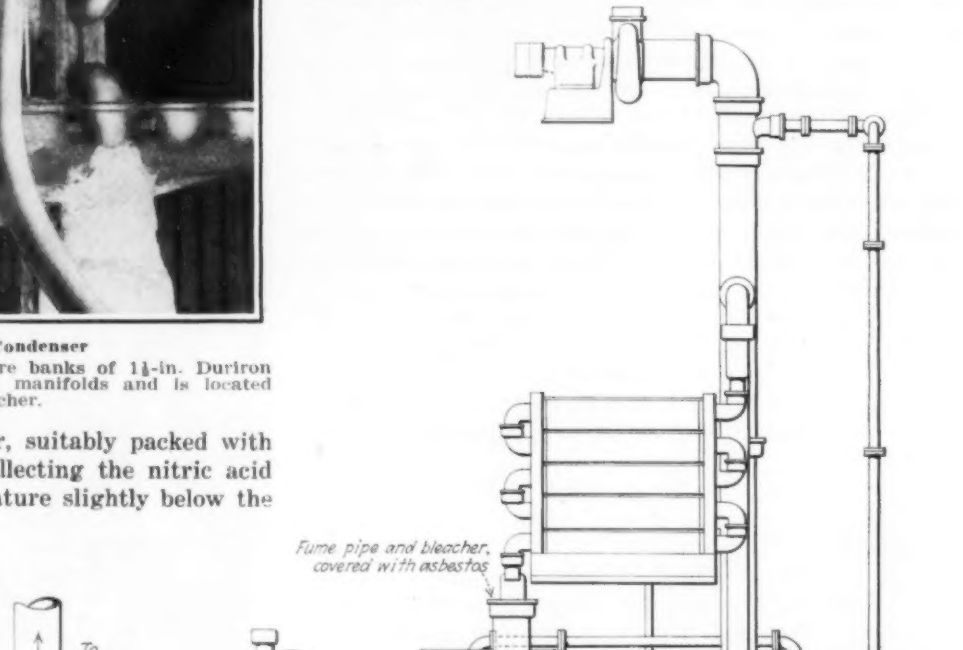


Fig. 3—Side Elevation of the Plant
The plant illustrated is designed to hold a maximum charge of 250 lb. of nitrate of soda and 275 lb. of 66 deg. Bé sulphuric acid. Six complete charges can be made in 24 hours.

With the exception of the still, the entire plant, including piping, bleacher, hyponitric tower pump and fan, is constructed of Duriron. Although particular stress has been laid on the advantages of this design for the construction of small units, the same advantages are obtained in units of large construction, and it is entirely practical to build plants of any size from standardized designs and parts.

In charging the still, dry nitrate of soda is introduced through a flanged opening in the top of the cover. Sulphuric acid is pumped through a suction hose from a carboy by the hyponitric tower pump to the charge pot located above the still, from which it flows by gravity. The rate of charging into the still is controlled by a valve located in the charging line.

No trouble whatever has been experienced in keeping the stuffing boxes tight; in fact, they have not been repacked during the experimental run extending over a period of about two years. This is accounted for by the extremely slow speed of the shaft. Previous attempts to agitate the mass by means of an ordinary stirrer in the hemispherical type of still resulted in complete failure because at a certain point during the reaction the mass becomes viscous, finally solid, thus preventing the rotation of the stirrer. The use of disk agitation avoids this difficulty entirely, as the disks maintain a free part for themselves during the solidifying stage of the reaction.

The plant illustrated is designed to hold the maximum charge of 250 lb. of nitrate of soda and 275 lb. of 66 deg. Bé. sulphuric acid. The time required for running the charge is such that 6 complete charges can be made in 24 hours. About 90 per cent of the total yield is obtained from the bottom of the bleacher as strong acid running from 87 to 89 per cent HNO_3. A large

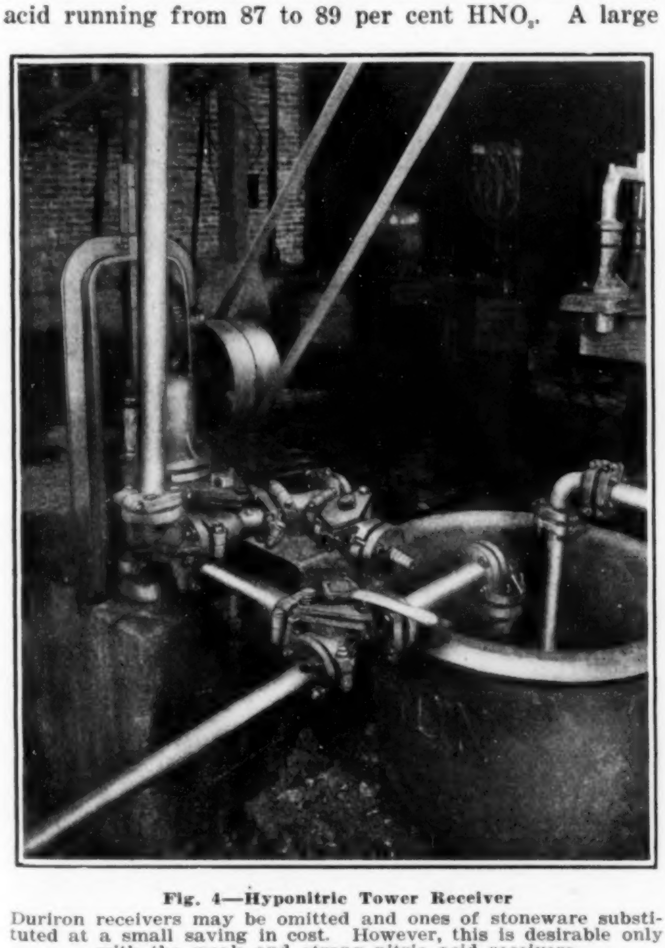


Fig. 4—Hyponitric Tower Receiver

Duriron receivers may be omitted and ones of stoneware substituted at a small saving in cost. However, this is desirable only with the weak and strong nitric acid receivers.

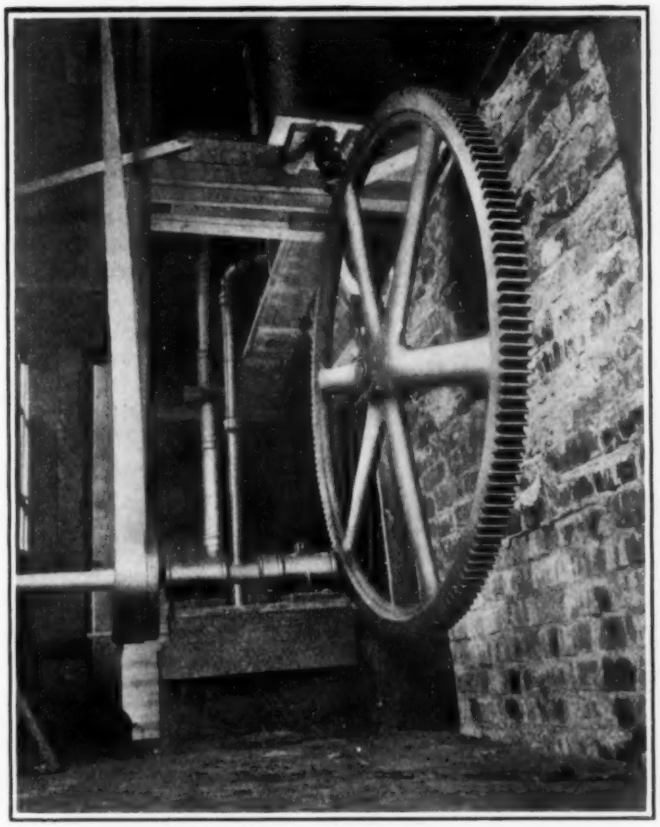


Fig. 5—Retort Setting

The charge of sodium nitrate and sulphuric acid is agitated continually and the nitric vapors are allowed to escape freely at a comparatively low temperature.

number of runs has demonstrated that each 100 lb. of 96 per cent nitrate of soda will produce 102 lb. of 67.18 per cent (42 deg. Bé.) nitric acid when 93 per cent sulphuric acid is used, making a plant of this size capable of producing 1,530 lb. of 42 deg. Bé. acid in 24 hours. Stronger acid can be produced by moisture free nitrate of soda and a higher concentration of sulphuric acid.

The whole plant is designed in such a way that maintenance is reduced to a minimum. The labor involved is very slight; in fact, it can be operated by one man who will still have considerable time to devote to other duties. The fuel consumption is very low and the plant can be fired with either coal, coke or wood. Experience has shown that a very small wood fire will produce all the heat necessary and that the firebox of the nitric plant is a convenient way of disposing of an accumulation of refuse lumber.

With the disk agitator type of nitric acid still, every disadvantage inherent in the old type of pot atmospheric as well as the vacuum type of still is overcome. In addition, the advantages of the vacuum type are obtained at a fraction of the initial expense of plant and much less upkeep. The floor space occupied by the disk type with all equipment such as condensers is just about one-third that required by the vacuum and atmospheric type of plant, that is for an equal weight of nitrate of soda decomposed per unit of time.

Owing to the complete mixing of soda and sulphuric acid from the start, the evolution of nitric acid vapor is remarkably constant, and the time required for each run is uniform. Condensing equipment may be of minimum size owing to the absence of peak evolution of vapor. The disks remain clean, and there is no inclination for the charge in the still to build up on the disks

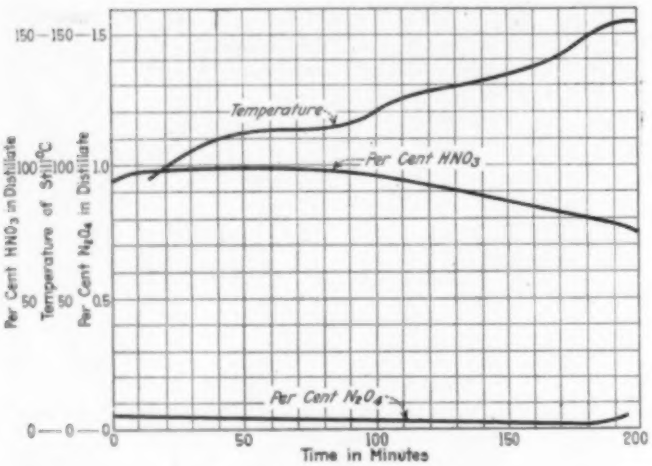


Fig. 6—Operating Curves
By jacketing the bleacher, it can be preheated at the beginning of the run making possible the removal of the low oxides of nitrogen at the start.

which, of course, are perforated. Fuel consumption is much less, the temperature of the still and brickwork is lower which all makes for long life. An examination of the packing and stuffing boxes on the shaft supporting the disks after one year of operation showed that no appreciable wear had occurred. This is due to the construction of the still, whereby all weight and strain are carried on the body of the still itself.

If unusually strong nitric acid is required, and the sulphuric acid obtainable is not of great strength, the nitrate of soda may be dumped into the still, and with the disks revolving, the heat of the still will in a very short time thoroughly dry the nitrate of soda and this material will be in a beautifully pulverent state, the ideal physical condition for reacting with the sulphuric acid as is run into the still. Under these conditions, the drain at the bottom of the hydrometer boot is open, in order that the condensate may be run off.

Another feature that has not been touched upon is reaction between the sodium chloride and the sulphuric acid, by this is meant the salt (about 1 per cent) that is always present even in the 96 per cent sodium nitrate. It has been found that ordinary sodium nitrate contains the sodium chloride largely on the surface of the crystals. With good agitation as in the disk type of still,

Fig. 7—The Hydrometer Boot
A drain at the bottom of the hydrometer boot may be opened, allowing the condensed water from the sodium nitrate to be separated from the product.

the sulphuric acid comes into intimate contact with the crystals and the hydrochloric acid from the reaction being very volatile, escapes at the start and before much nitric acid distills in this way, the troublesome formation of nitrosyl-chloride is avoided, the hydrochloric acid escaping through the system. This is an important feature.

Sharing Plant Management With the Workers

Dutchess Bleachery Adopts Plan That Holds Promise for Others

By Mary Van Kleeck
Director, Department of Industrial Studies, Russell Sage Foundation

THE Dutchess Bleachery, Wappingers Falls, N. Y., is one of the largest mills of its kind in the country, usually employing about 600 workers—450 men and 150 women—including a considerable number of Italians. Familiar causes of unrest had existed among the workers—long hours, low wages, and bad living conditions. The workers were restive and suspicious. The firm seemed to them to have no interest in them as human beings. They felt insecure in their employment. A man could be discharged by the foreman without notice, and with no explanation. As the Bleachery is the chief industry in the town, discharge often forced a man to break up his home and to move his family to another community.

When the present owners took over the plant some years ago they had no means of knowing the state of mind of the workers. Naturally, they laid plans at once to make the business as profitable as possible. They erected a new mill. They engaged a new executive staff. Arbitrary rules and decisions began to give way to friendliness and consideration. Where suspicion had prevailed before, pleasant personal relationships developed between foremen and workers.

For several years, however, the need for forming more than pleasant personal relationships was not recognized. Back of the discontent of the workers were two large problems which confronted industry generally today—insecurity of employment and the lack of any definite plan of representing the point of view of wage-earning employees when wage rates, hours of work, and other conditions in the plant are decided upon. Added to these problems was the dilapidated condition of the company-owned houses, in which most of the workers lived. They had been badly built, and considerations of economy had left them to deteriorate into unsanitary living places. Under these conditions the employees were not happy, nor did they feel any personal interest in the success of the business. Enlarged profits did not have any tangible results in improving their living conditions, decreasing their hours of work, or increasing their wages.

Fortunately, the new owners of the Dutchess Bleachery were men of vision, fitted to understand human needs in the work shop. They also had broad experience in the successful management of industrial enterprises, owning four other mills. One of the officers of the company had been led to make an analysis of industrial organization because a friend of his had declared that no industry was run on ethical principles.

His analysis led to the conclusion, in which other active directors concurred, that industry failed to satisfy the needs of its employees on three counts:

First: The managers of large operations lack personal contacts with their own employees. Without these contacts they are unable to understand the point of view of the wage-earners to see how disadvantageous conditions affect them.

Second: Industry provides no stimulus to creative work. The worker is limited to one small job and has no information about the industry as a whole, nor can he see his share in it. The prosperity of the business seems to him to be quite independent of his own efficiency.

Third: Not only does the worker fail to see that his small task is important in total production, but he is skeptical as to whether he receives his share of the earnings of the business. He knows that the foreman can tell him tonight that there will be no work for him tomorrow. He does not feel that he has any permanent place in the business. He has no permanent stake in industry, no information about its financial condition, and hence no stimulus to a sense of responsibility.

The Partnership Plan, as gradually evolved in the Dutchess Bleachery, was directed toward remedying these three defects. It aimed to give the workers a voice in the conduct of the business, to give them current information on the success of the business, and to share profits with them, besides providing funds in advance to enable the business to make payments to both stockholders and wage-earners in periods of industrial depression.

The participation of employees in the conduct of the business is secured through three boards:

(1) The Board of Operatives: It consists entirely of employees, elected by their fellow-workers. It has entire charge of the company houses, deciding upon all requests for repairs and other details connected with their management. Provisions for recreation and for education, not only for employees but for the whole village, are under its supervision. It is also the channel for presenting to the management any grievances of individuals or of groups of workers in the bleachery.

(2) The Board of Management: This is a joint body composed equally of employees elected by the Board of Operatives, and stockholders chosen by the Board of Directors. All important questions relating to the conduct of the bleachery, such as rates of wages and hours of work, are decided by this board.

(3) The Board of Directors, which is elected by the stockholders, consists of representatives of the operatives, the town of Wappingers Falls, and the stockholders. It formulates the financial policies of the company.

To meet the problem of insecurity of employment, sinking funds are set aside to pay part wages when workers are idle because of industrial depression, and also to pay a return on the investment of stockholders. A direct stake in the success of the business is insured through an equal sharing of profits by stockholders and wage-earners. Finally, in accordance with the procedure of a practical business partnership, the books are open to employees and they are kept continually informed concerning the state of the business.

At a mass meeting of the employees, the treasurer of the company explained in detail the idea of the Partnership Plan. First he defined the three groups which, in his opinion, make up a company, using the Dutchess Bleachery as an illustration: (1) The manufacturing group, composed of all those who work for the company at Wappingers Falls; (2) the selling and administrative group, composed of all persons working elsewhere for the company, such as salesmen, officers, accountants, and others engaged in clerical and other work; (3) the group which supplies the property and the capital to operate it.

Relationships between these three groups, he said, should be "those of partners." It was necessary at this point to define what partnership means. Indeed, an explanation of the purpose of the owners was due the workers. For almost a century the practice in this plant, as in many other industries, had been for the workers to go through their daily rounds of so many hours at so much per hour, with no voice in any phase of the business. Now a mass meeting was called to invite these wage-earners to become partners. No strike had occurred. Naturally the workers were both curious and suspicious. They listened eagerly as the new plan was explained to them.

Partnership required first, said the treasurer, a fair share in the responsibility of management for each partner:

> In a partnership each partner shares the responsibility of management, by taking charge of that division of the business which he is best qualified to handle. One partner may direct the finances, another the buying, another the selling, another may check the credits for all customers, another the advertising end—each that part of the work for which he has prepared himself or for which he is naturally best fitted. So here at Wappingers Falls your Board of Operatives, representing you and chosen by you, manage the questions of housing, recreation, education, etc., just the matters which they are best qualified to manage.

Partnership requires, in the second place, the treasurer said, that each partner be informed of the earnings and other phases of the business:

> Partners are entitled to know the general results of their joint efforts and here, again, your Board of Operatives, as your representatives, will be fully informed of the results of the year's business, receiving the report of the net earnings (prepared by independent auditors) just as does the Board of Directors.

The third essential in a real partnership, he said, is that "partners share in the final net profits of the company after all proper expenses have been paid. . . . "

How the Plan Worked Out

Does this sound like too radical a change in the status of wage-earners in business? As a matter of fact, it has proved to be a sensible and practical plan for dealing with the causes of friction which are familiar to every industrial manager.

Discontent due to housing conditions would have become even more serious if the operatives themselves had not been given responsibility for administering housing, thus being assured that their interests were not being neglected. Industrial managers who administer company-owned houses know how readily employees and their families are led to believe that absentee owners are pocketing funds which might otherwise be available for better housing. Through enlisting the aid of the employees themselves, and giving them a budget to administer, their co-operation was won in a gradual but steady improvement in the property, requiring less outlay of funds and considerably more satisfaction than

would otherwise have been possible. Equally important was the fact that the employees' interest in the care of the property was stimulated since the profit sharing scheme, combined with information about the business, made them realize that the money spent on housing came out of profits.

More substantial than the attitude of the employees, however, are the actual results in improving the company-owned workmen's homes through building new foundations, putting on new roofs, installing water and sewer connections, and painting almost all of the buildings, until the village assumed a new aspect. Similarly, it was the Board of Operatives who inaugurated an educational and recreational program growing directly out of the needs of the people in the village. Baseball, basket-ball, tennis, games for children, classes in cooking, stenography, economics, Italian, and English to Italians, were provided for evenings and week-ends.

The Partnership Plan proved to be also a practical business necessity in meeting the problem of low wages. Bleaching is a low wage industry. It is a service industry, carrying on one process in cotton textile-making, and is run on a small margin of profits with keen competition. Without the Partnership Plan, which took the workers into the confidence of the Board of Directors and enabled them to understand the competitive problems of the industry, discontent among the employees would have been fed by suspicion of the policies of absentee stockholders and managers.

Until the standards of the industry can be raised, the Partnership Plan at the Dutchess Bleachery is the essential guaranty to workers that it is not the greed of capital that is keeping their earnings low, but rather that this is a practical problem of the industry to be solved patiently and co-operatively. The low wage scale has demanded, also, the kind of provision for unemployment which the sinking funds connected with the Partnership Plan insure. These funds prevent the distress which would be caused by idle time when rates of pay are wholly insufficient for savings.

That the employees very quickly realized the financial problems of the Board of Directors was evidenced in their decisions as members of the Board of Managers. They suggested such methods of increasing efficiency as timeclocks, foremen's conferences, and mass meetings. Together with representatives of the stockholders they elected the present manager and superintendent of the mill, and the successful conduct of the plant by these men demonstrated the good judgment of the employees, for it was their representatives who actually suggested the new executives. The whole tenor of their participation has been not "How much can we get out of the bleachery for ourselves?" but "What can we do to make this a successful and efficient enterprise for everyone concerned?"

Attitude Toward Production Revolutionized

It is the testimony of foremen and managers that the Partnership Plan has revolutionized the attitude of the operatives toward production. To cut down waste, to make certain that no goods were spoiled in the process of bleaching, to finish the greatest number of yards in a given time, insured an increase in profits and a larger net income to each operative. Here was an incentive, direct and personal, such as only proprietors of a business have heretofore experienced.

The Board of Directors has had a practical demonstration of this new interest in production. During the last period of severe industrial depression, when other bleacheries were often idle, the Dutchess Bleachery earned comparatively high dividends. Operatives point out that what they call the "partnership finish" in the quality of their work is an improvement in the product directly due to the partnership spirit.

The Dutchess Bleachery experience has revealed the practicability of better co-operation between stockholders, directors, and wage-earners. The stockholders took the initiative in laying the foundation of the plan, in limiting their own profits to a given percentage and dividing the surplus, and in extending more and more power to the workers as their capacity for it was demonstrated step by step. The operatives have shown a growing ability to participate in the management of the plant with intelligence and responsibility, and to work out a program for the welfare of the community in which they live.

Lessons of the Experiment

Several fundamental conclusions emerge from this experience for the enlightenment of other industrial companies who, facing a similar situation, wish to find the way out by granting workers participation and responsibility in management. There are six elements of strength in this plan:

First: It was based on an intelligent study of the way industrial organization and policies actually affect the men and women who work in the shop.

Second: Responsibility for administering the plan was given to an officer in whom the directors had confidence, so that he could be the advocate of the interests of the workers even against initial opposition by executives in immediate charge of factory operations.

Third: This officer had also the confidence of the workers and he increasingly gained it so that he was able to stimulate and develop leadership among them while knowing how to work also with the local managers, superintendents, and foremen.

Fourth: The plan was developed step by step by an experimental method. Instead of announcing a finished scheme of organization to the workers, and then refusing to grant any additional powers, a very simple beginning was made by giving the operatives charge of housing. They had at first only an advisory relation to plant management. Their place on the Board of Managers was given at their request after they had demonstrated what they could do as members of the Board of Operatives.

Fifth: It was not offered to the workers as a substitute for a trade union. Far from attempting to destroy the effectiveness of the folders' local union, which is part of the United Textile Workers, the officers of the company demonstrated their interest in trade union organization and won the support of trade union members in their employ. If they had not won their support, the confidence of all the operatives in the sincerity of the owners would have been undermined.

Finally, the plan offered substantial gains, such as a share in profits, and funds for unemployment. It gave the workers more than an advisory right to "confer" with managers. Their vote on questions of shop management, including wage rates and hours of work, was decisive. In return, there has been an unfailing response to any reasonable demand made by the management to increase the efficiency of the plant.

Sick Sulphuric Acid Plants

Poor Design and Unintelligent Operation Are the Chief Causes of Inefficient Performance in Chamber Acid Plants

By Andrew M. Fairlie
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A SULPHURIC acid plant, having so many organs that function like those of the human body, can behave in some respects in a similar manner. An acid plant cannot laugh, or talk, or walk; but it can eat, drink, digest and breathe. Also, if something is wrong with one or more of its numerous organs, it can get sick. Some acid plants are born sick; some acquire sickness; and some have sickness thrust upon them. The diseases of an acid plant, then, may be either congenital or acquired.

Fig. 1—A Modern Chamber Process Sulphuric Acid Plant

The congenital diseases, as a rule, are the harder to cure. They are the defects inherent in the plant when it was new—defects due to faulty design or faulty construction, or both. The congenital diseases can almost never be cured without an operation, and the operation will be a minor or a major one, according to the gravity of the defect. One acid plant operator started a new blower, and ran it for two days, all the time wondering why it produced no draft. Then it was discovered that the discharge flue was stopped up by a dead-head placed there temporarily by a workman during the installation of the blower. This was a small matter, and the minor operation of removing the dead-head cured the disease.

In another instance, a mining engineer was once engaged to design a sulphuric acid plant. He insisted, despite the protests of his subordinates, on connecting the acid supply pipes for the two Gay-Lussac towers in reverse order, so that the Glover acid was pumped to the first Gay-Lussac tower, and the discharge from this was pumped to the second Gay-Lussac tower. After starting the plant it was found at considerable expense that the nitrogen oxides absorbed in the first tower were largely lost again by denitration in the second. This illness was more easily diagnosed than the dead-head blunder, but was more difficult to remedy. The operation required, however, was still a minor one.

Some of the congenital diseases are more serious. For example, at one plant the Glover tower was located too far away from the sulphur burners, and, with the niter pots inside the flue at the Glover end and with the flue improperly insulated, the burner gases lost so much heat before reaching the niter pots and the Glover tower that it was impossible to "cook" the niter or to concentrate the chamber acid. A major operation was necessary. The niter pots had to be moved closer to the burners, and the flue had to be rebuilt, with insulating brick in the walls.

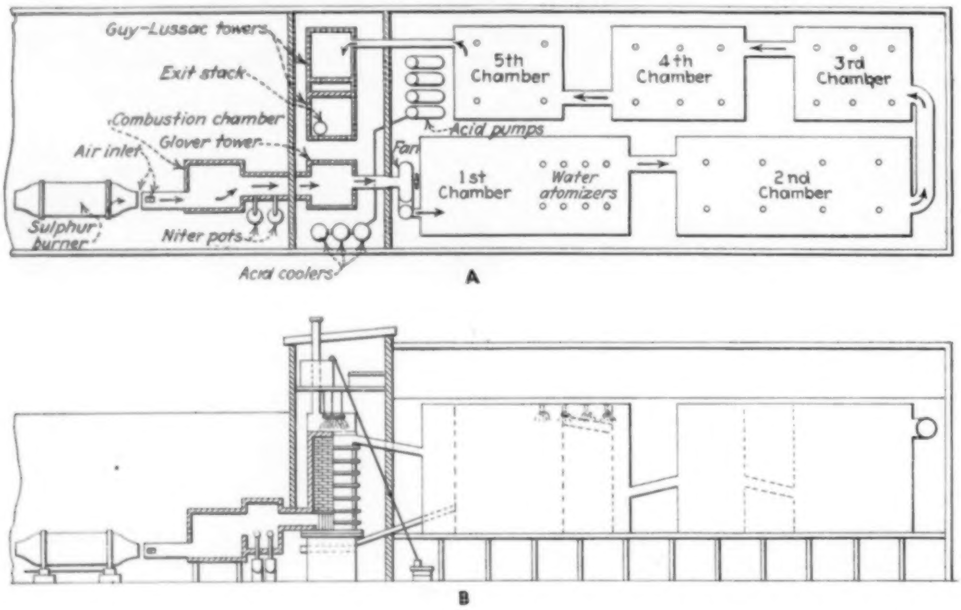
Many unfortunate mistakes have been made in the design of sulphuric acid plants. The dust chamber has been built at the wrong end of the main gas flue, with the result that the dust accumulated in and choked the flue, and by the time the gases reached the dust chamber, there was little dust left to be precipitated. Gas connections between chambers have been built without first calculating the proper size the connections proving to be too small. Gay-Lussac and Glover towers have been too closely packed, and have had to be unpacked and repacked before the plant could be efficiently operated. Towers have been too loosely packed, and have proved to be inefficient absorbers or denitrators or concentrators. Towers have been packed with material that was not acid-proof, which soon disintegrated,

Fig. 2—Chamber Process Sulphur Burner House

necessitating costly repacking. Attempts have been made to filter dust out of hot gases, with the result that as soon as some dust was deposited on the filter, the gas was filtered out as well as the dust, and the filter had to be scrapped. Chamber plants have been built with chambers too large in size, and too few of them, and such plants continued to operate inefficiently until the shortage of lead surface was made up by the addition of more chambers, of smaller size. The type of equipment for elevating acid to tower tops has been poorly chosen and has had to be scrapped, and replaced with an efficient type.

A new chamber plant, properly designed and constructed, ought to start smoothly, and be in full efficient and economical operation, at the latest by the end of the first week. But how many ailing plants there have been, that have had to suffer for weeks and even months, enduring one major operation after another, as the congenital defects were slowly discovered and corrected! Sometimes they are never discovered, and the plant goes limping along, from birth to death, like a child born with a club foot, the owners being unaware that the disease can be diagnosed, and the bar to efficiency removed.

Some plants acquire sickness. In fact, most of them do unless they are very efficiently supervised. A certain plant in a northern state had operated efficiently for 5 years. Then the niter consumption began to increase, and the sulphur recovery to diminish. Time brought no improvement; on the contrary, costs went higher and higher, month after month. A year went by, then a second year, and results grew worse and worse. Could the plant "come back"? Or was the acid plant getting old? And was an old acid plant like an old man, that had to be permitted to live its course, die, and be buried? These were the dubious and gloomy questions that were asked. At last the owners came to the conclusion that the acid plant was not old, but had acquired some disease. A specialist was called in, and after careful examination, he confirmed this conclusion. But the bad symptoms were attributed, not to one disease only, but to a complication of diseases, no one of them very serious in itself, but the combination productive of a cumulative effect that had increased the cost of making acid more than 100 per cent. The diseases were not all discovered at once. But as each one was found, a remedy was applied. And the recovery of the patient was not sudden. But soon after the specialist began his treatment, an improvement was noted, and as time went on, the improvement became more pronounced, until, after a few months, the patient was convalescent, and finally was pronounced cured. Since the complete recovery of this acid plant, there has been no relapse. A finger is kept constantly on the pulse of the plant, and at the slightest indication of a feeble heart beat, or a rise in temperature, especially in the last chamber, the cause is sought for, and the remedy is applied.



B

Fig. 3—Chamber Process Acid Plant Diagram

The gases from the Glover tower proceed through a series of lead chambers as shown in diagram *A* where with the aid of water introduced as a fine mist, the sulphur dioxide not converted to sulphuric acid in the Glover tower reacts, and the nitrogen oxides then pass to the Gay-Lussac towers to be absorbed by the acid pumped from the Glover tower. The nitrous sulphuric acid from the Gay-Lussac towers is pumped to the Glover tower to be denitrated.

Some plants have diseases thrust upon them. A plant designed by a competent engineer, and built by a reliable construction company, had never operated as efficiently as the owners had a right to expect. The niter consumption and sulphur recovery were not bad, yet they were not good. They were only fair. For four years the management put up with fair results. Then they decided they must have the best possible results and they determined to find out what was wrong with the acid plant. The problem was placed in the hands

of a specialist. A careful examination was made and the symptoms of the plant were closely observed. Nothing was found wrong with plant or equipment. Chambers, towers, pumps, coolers, acid distributors, sulphur burners, drafts—all parts of the plant were found to be in order and in a good state of repair. But the process was badly controlled by the operatives. Irregularities in the flow of acid over the Gay-Lussac towers resulted in inefficient recovery of the niter fumes, with the production of a nitrous vitriol that was of varying composition. Feeding such nitrous vitriol to the Glover top caused a "streaky" process in the chambers, reacting adversely again on the niter recovery. Moreover, the "streaky" process resulted in a loss of sulphur dioxide from the exit stacks. In this case no surgical operation was required. The training of the operatives was the cure. But this cure, like the other, required time. No change in personnel was made. The men composing the acid plant crew were taught proper methods of chamber plant control and the results were a gradual improvement, then a convalescence, and finally a cure. These two cases are typical, the first of a plant that had once been well, and had acquired a sickness from lack of competent supervision and attention to maintenance; and the second of a plant, physically all right, but made sick by inefficient control of the process by unskilled operatives.

In a sulphuric acid plant, with many of its organs analogous to the complex organs of the human body, one lack stands out conspicuously. There is no brain. This complicated plant is not an automaton. It can only operate when controlled by the human mind, and the human mind learns only by experience. Hence the chamber plant will operate most efficiently when controlled by minds trained by thoughtful experience gained in previous operation of chamber plants. The plant must have frequent inspections, and any tendency towards disease of any part must be corrected in the beginning. In an acid plant, a stitch in time saves ninety-nine. Such measures will tend to prevent the acquired diseases. To avoid all kinds of sickness, congenital as well as acquired, experience in *operation* must be freely utilized during the *design* and *construction* of the plant, as well as for its operation and maintenance.

Cost of Industrial Heating

A Discussion of the Cost of Operating Furnaces With Various Sources of Heat and a Tabulation of the Cost Figures

By D. J. Demorest
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THERE is presented herewith a comparison of the cost of heat, as applied to typical heating operations, for various fuels and electricity used at customary efficiencies. The efficiency of each source of heat is calculated for furnaces operating (or discharging) the products of combustion at about 200 deg. C., 900 deg. C. and 1,300 deg. C., corresponding roughly to the discharge temperatures of a steam boiler, a steel castings annealing furnace and a forging reheating furnace.

This table takes account only of the heat available from various sources and compares the costs of 100,000 B.t.u. from these sources. Handling costs are not considered, nor are possible savings arising from cleanliness of use or ease of application. For instance, it is undoubtedly much cleaner and more satisfactory to use electricity for heating than coal, provided the electricity is not too high in cost. Furthermore, it is undoubtedly true that in some processes less material is spoiled with one method of heating than with others, and unless there is a cost factor working too strongly against this one method of heating it should be used.

In general, it is probably true that electric heating gives the cleanest and most satisfactory furnace conditions and causes a smaller amount of rejected material due to overheating, oxidation, etc. At least this has been true in the past, but in recent years there has been a great improvement in the design of fuel-fired furnaces and burners. As a result, the best designed gas-fired furnaces now compare favorably from the standpoint of quality of product with electric heated furnaces. As a result it is nearly correct to decide what type of heating equipment to use on the basis of the cost of heating alone. It is impossible, of course, to make a generalization that will fit all cases. In some operations it is doubtless better to heat with electricity regardless of cost, but the advent of properly designed muffle and semi-muffle types of furnaces along with surface combustion burners makes the advantage of

Source of Heat	Per Cent Air Excess	B.t.u. Value of Fuel	Temp. of Furnace, Deg. F.	Price of Fuel or Elect.	Cost per 100,000 B.t.u.	Per Cent Heat Lost: in Flue Gas Non-Recuperating	Per Cent Heat Lost: Recuperating	Per Cent Heat Lost: By Radiation	Cost per 100,000 B.t.u.: Without Recuperation	Cost per 100,000 B.t.u.: With Recuperation
	50	12,500	400	$4.00 per ton	$0.016	10.5		5	$0.019	
Bituminous......	50	12,500	1600	$4.00 per ton	.016	50.5		10	.041	
	50	12,500	2300	$4.00 per ton	.016	75.0		15	.160	
	10	535	400	$1.75 per 1000 cu.ft.	.140	6.5		6	.158	
City gas.........	10	535	1600	$1.75 per 100J cu.ft.	.140	31.0	16.0	10	.238	$0.185
	10	535	2300	$1.75 per 100υ cu.ft.	.140	46.5	20.0	15	.364	.240
	10	1,100	40υ	$0.50 per 1000 cu.ft.	.046	10.7		5	.0545	
Natural gas......	10	1,100	1600	$0.50 0er 1000 cu.ft.	.046	50.5	27.0	10	.117	.073
	10	1,100	2300	$0.5υ per 1000 cu.ft.	.046	76.0	33.0	15	.510	.110
	10	300	400	$0.30 per 1000 cu.ft.	.100	7.0		5	.114	
Water gas.........	10	300	1600	$0.30 per 100usq.ft.	.100	32.0	15.0	10	.172	.137
	10	300	2300	$0.30 per 1000 cu.ft.	.100	51.0	20.0	15	.293	.185
	10	150	400	$4.00 per ton coal as gas	.032	10.5		5	.0380	
Producer gas*....	10	150	1600	$4.00 per ton coal as gas	.032	50.0	22.0	10	.0800	.052
	10	150	2300	$4.00 per ton coal as gas	.032	75.0	37.0	15	.355	.068
		3,415	400	$0.015 per KWH.	.440	0.0		5	.456	
Electricity.......		B.t.u. per	1600	$0.015 per KWH.	.440	0.0		1υ	.488	
		Kw.-Hr.	2300	$0.015 per KHW.	.440	0.0		15	.518	
	20	135,000 per gal.	1600	$0.06 per gal.	.045	8.5		5	.052	
Fuel oil†.........	20	135,000 per gal.	1600	$0.06 per gal.	.045	43.0	22.0	10	.096	.065
	20	135,000 per gal.	2300	$0.06 per gal.	.045	66.0	30.0	15	.240	.092

* Witn 10 per cent by volume of steam in gas.
† Using ½-lo. of steam per lb. oil.

electric heating from the point of view of the quality of the product a very slight one. In most cases, a gas-heated furnace properly designed and using the proper kind of gas will turn out as high quality product as an electrically heated furnace.

If the statements made above are true (and the writer believes them to be approximately correct), then the selection of the fuel to use in any process is purely a matter of the cost of heat as shown by the table. The exception to this statement is encountered when solid fuel is used, because the use of such fuel involves more or less expensive stokers and the cost of handling the solid fuel and the ash. Aside from this correction the table can be used with a good deal of confidence, since the cost of handling gas through burners is an insignificant item, as is the cost of handling electricity through switches.

The table is based upon average prices of fuels and electricity in the Middle West, when these are used in large quantities. If one knows the cost of a fuel in his locality the figures given in this table can be easily corrected to the cost for that locality. For instance, if fuel oil should cost $0.08 per gallon instead of $0.06 as given in the table then cost figures should be increased by multiplying by 1.33, or if city gas costs $1.25 per 1,000 cu. ft., the costs should be increased by multiplying by 1.66, or if electricity costs $0.02 per kw.-hr. the costs should be increased by 1.33.

The table gives the costs of heat when the furnace using the heat operates non-regenerating or regenerating. The products of combustion of a furnace leave the furnace as hot as the furnace is, and if this heat in the hot products of combustion is recovered by preheating the air which is to be used for burning the fuel, then the furnace is operated regeneratively. Tables that have been published for commercial purposes comparing the costs of electric heating and fuel heating are misleading when the cost of fuel heating is calculated only on the non-regenerative basis. In the table herewith costs are given when the furnace temperatures are 392 deg. F. (200 deg. C.), 1,652 deg. F. (900 deg. C.) and 2,372 deg. F (1,300 deg. C.), the next to the last column giving the costs per 100,000 B.t.u. when regeneration or recuperation is not used and the last column giving the costs per 100,000 B.t.u. when regeneration or recuperation is used, except for coal and for a furnace temperature of 392 deg. F. The last column, giving the costs with regenerative operation, is calculated on the basis that the air used for combustion is heated by the recuperator or regenerator to a temperature 60 per cent of that of the hot gases leaving the furnace about what can be attained by recuperative methods. From this it will be seen that enormous savings are made by recovering what would otherwise be waste heat and returning this heat to the furnace. Of course, it takes additional investment to install recuperators, but it is eminently worth while. The figures in the last column speak for themselves.

Coke and Byproduct Figures Available

"Coke and byproducts in 1922" by F. G. Tryon of the U. S. Geological Survey gives a comprehensive statistical report and a critical interpretation of the byproduct and beehive coke industry. Copies of the report are obtainable on application to the U. S. Geological Survey.

Legal Notes

When Is a Contract Voidable?

Specific Cases in Which the Courts Have Held Cancellation May and May Not Take Place

IN THE business world probably most frequent cause of dispute between individuals and companies is over the construction of contracts. Even when the parties to a contract believe they have been careful to incorporate in it provision for every contingency that can arise, the court may find that it is basically unsound.

Must Be Mutuality

Such a case, for instance, was that of the Miami Coca-Cola Bottling Co. against the Orange Crush Co. to prevent cancellation of a contract. The Federal District Court held that there was no mutuality as to remedies and that the contract was not enforceable. The contract in question purported to convey to the plaintiff a perpetual right to manufacture and sell orange crush in two counties in Florida. The contract could be cancelled at any time by the plaintiff by giving written notice. The defendant could cancel only if any of the terms of the franchise were violated by the plaintiff.

The defendant refused to furnish the plaintiff with the concentrate from which the orange crush was made and the Miami company sued for a mandatory injunction compelling the defendant to furnish it. The defendant contended that the difference in the rights of the parties to cancellation destroyed the mutuality of the contract.

With this contention the court agreed, and said that where the consideration for a promise of one party is the promise of the other, there must be absolute mutuality of engagement, so that each party has the right to hold the other to a positive agreement. In other words, both parties must be bound or neither will be bound. In this case the court held there was no doubt that the contract was wanting in mutuality as to remedies.

To illustrate the point, the court cited what would happen if the parties to the suit were reversed and the Orange Crush Co. were suing the Miami company for not living up to its agreement. In that event, said the court, as soon as an injunction were sought, the Miami company could terminate the contract by simply giving written notice, and there would be no remedy for the Orange Crush Co.

What Is Meant by Words "No Arrival, No Sale"

Another case in which mutuality of contract was the issue related to nitrate of soda to be shipped from the west coast of South America. The contract contained the words, "No arrival, no sale." When the buyer refused to accept delivery of the nitrate, the seller sued for the difference between the contract price and the market price. The buyer claimed that the contract was void for want of mutuality, but the Circuit Court of Appeals held that the words, "No arrival, no sale," were intended merely to relieve the seller from

liability if, from causes beyond his control, he could not deliver the nitrate of soda. There were reciprocal obligations, the court held, binding one party to furnish the nitrate and the other to take it and pay for it.

Can Be No Cancellation in Face of Specific Words Forbidding It

In another suit on a contract the buyer sought to cancel his agreement to purchase iron bars for anchor chains because the United States Government had cancelled its contract with him. This contract contained the words, "This is an irrevocable contract and is not subject to cancellation, suspension of shipment, or to any change in price due to market conditions, except as specifically stated herein." When the war ended, the government cancelled its contract, but the court ruled that this did not relieve the buyer of responsibility, since the inference from the quoted words was that the question of contingencies of war had been taken up between the parties and resulted in the stipulation that the contract should be irrevocable. The court pointed out that if the government's cancellation of its contract were a justification for buyer's repudiation, then similarly seller's unconditional contract with the furnace company for pig iron could be repudiated, likewise the furnace company's unconditional contract with the mining company for the ore, and so on back to the ultimate raw state in all materials.

Recent Articles in the Foreign Technical Literature

Acid-proof Lining for Concrete Tanks. An acid-resistant composition, having sulphur as a base, is applied direct to the concrete surface. The coating is seamless and the adhesion is excellent even when subjected to wide extremes of temperature. The lining withstands temperatures up to 110 deg. C. *Chem.-Zeit.*, Jan. 3, 1925, p. 20.

The Cause of Bursting of Tubes in Vacuum Evaporators. B. Neumann and E. Zöllner. The frequent bursting of tubes during evaporation of caustic soda or sodium aluminate solutions is due neither to chemical nor mechanical action, but to stresses set up in rolling the tubes or in setting them in the evaporator. Except for great care in rolling and attaching the tubes, there is no known means of prevention unless an entirely different method of attaching the tubes is adopted. *Z. Elektrochem.*, Jan. 1925, pp. 24-31.

The Manufacture of Iodoform on a Factory Scale. The most efficient production is attained by a combination method, the first process being the production of CHI_3 from dilute alcohol, KOH and I and the second being electrolysis of the KI formed in the first process. The electrolysis is carried out in dilute alcohol solution through which a current of CO_2 is passed. *Chem.-Zeit.*, Jan. 3, 1925, pp. 18-9.

Asbestine and Its Uses in the Paper and Chemical Industries. E. Altmann. In addition to its use as a paper filler, asbestine is useful for increasing the absorption capacity of cheap blotting paper, for improving the color printing qualities of wall paper. It is also used in cardboard, vulcanized fiber, papier mache and oiled paper. Its chemical uses include deresinification of cellulose, metal polishes, fire extinguishing compositions, adhesives, plastics, insulation, filter plates and a variety of minor uses. *Chem.-Zeit.*, Jan. 8, 1925, pp. 34-5.

Heating With High Pressure Steam. R. Tillmann. Although the critical temperature of water is 374 deg. C., temperatures as high as 400 deg. C. have been observed in hot water heating installations. To determine whether hot water or high pressure steam heating is preferable, each case must be studied individually. In general, the lower the temperature required in the apparatus to be heated, the greater the advantage for high pressure steam. The greatest economy of operation is attained in those systems equipped with a pump for returning the condenser water to the boiler. *Chem.-Zeit.*, Jan. 8, 1925, p. 35.

Extraction Systems Used in the Manufacture of Tannin. E. Knape. The two most effective systems in use are: (1) aqueous extraction in closed copper diffusion batteries, and (2) extraction with ether-alcohol in rotary extractors. In the aqueous method, a battery usually consists of 12 diffusers in two rows of 6, or sometimes of 18 or more in a circle. The water should contain a preservative, e.g., phenol (1 kg. to 1,000 liters of water). The use of a volatile solvent and a rotary extractor is more economical, however, and is gradually displacing other methods. *Chem.-Zeit.*, Jan. 15, 1925, pp. 53-5.

A Tunnel Drier of Highest Efficiency. An illustrated description of the Haas drier, which has air turbine ventilation and is equipped for gradual rise or fall of temperature through the length of the drier. The material to be dried is not subjected to severe conditions, and the steam requirement is low. *Chem.-Zeit.*, Feb. 5, 1925, p. 120.

Current Theories of the Mechanism of Lime Burning. G. Keppeler. The dissociation pressure of $CaCO_3$ is scarcely perceptible at 600 deg. C.; it increases till it reaches 1 atmosphere at 900 deg. C. At this temperature the decomposition depends only on the flow of heat to the limestone. In practice the controlling factors are the dissociation pressure and the rate of penetration of heat into the limestone. Reducing agents (coal or H_2) are favorable to the reaction. *Z. für angew. Chem.*, Jan. 22, 1925, pp.77-8.

Recovery of CO_2 from Lime Kilns. F. Quincke. Lime kiln CO_2 is suitable for most industrial uses and can be obtained in 35 per cent strength if efficiently recovered. The product could be profitably disposed of for the single purpose of treating greenhouse plants and field crops to promote growth. *Z. für angew. Chem.*, Jan. 22, 1925, p. 78.

Utilizing Waste Heat from Lime Kilns. E. Laaser. Shaft kilns are better suited for waste heat recovery than annular kilns. A saving of 16 to 20 per cent is possible by using the waste heat for preheating the air for combustion in the kiln. *Z. für angew. Chem.*, Jan. 22, 1925, p. 78.

Mechanical Chloride of Lime chambers, Backman System. W. Lehmann. The Backmann process recognizes that the optimum temperature is different for each stage of the reaction in the chlorination of lime. The construction of the chamber is similar to that of a pyrites roasting furnace. It is automatic and requires little attention or repairs. *Chem.-Zeit.*, Jan. 22, 1925, pp. 75-6.

Improvements in Rotary Driers and Kilns. A new design of packing ring that prevents heat losses and entrance of air or escape of gases. The ring has three contact surfaces arranged to compensate for thermal expansion and for lateral and vertical irregularities in the rotating motion. Illustrated. *Chem.-Zeit.*, Jan. 22, 1925, p. 77.

Wool Washing and Extraction of Wool Fat. E. O. Rasser. The disadvantages of the alkali washing methods and the relatively high cost of saponifiable fats and oils are overcome by the use of a preparation made from sulfite cellulose liquor. In the extraction of wool fat, mechanical stirring does not give sufficiently intimate contact between the material and the solvent; stirring by air bubbles has been found preferable. Washing and fat extraction must be so carried out as to bring the fibers into most suitable condition for dyeing, carbonizing and other treatments. *Chem.-Zeit.*, Jan. 22, 1925, pp.73-5; Jan. 29, pp.94-5.

Advances in Beet Sugar Technology in 1924. E. O. von Lippmann. Progress is particularly noted in sap concentration, in some refining operations such as centrifuging and decolorization, and in chemical control. The discussion is largely confined to European practice. *Chem.-Zeit.*, Jan. 27, 1925, pp. 85-7.

Economic Aspects of the Utilization of Peat. J. Steinert. To be commercially successful, peat production must be carried on with the greatest possible use of labor-saving machinery; capital turnover should be made rapid by continuous instead of seasonal working and by cutting the time required for drying; the raw peat should be processed to increase its range of uses and lower transportation costs; and the markets nearest the sources should be actively cultivated. *Z. für angew. Chem.*, Jan. 22, 1925, pp. 61-7.

On the Engineer's Book Shelf

Short Biographies of Scientists

BEACON LIGHTS OF SCIENCE. By *Theodore F. Van Wagenen*. 460 pages. Thomas Y. Crowell Co., New York. Price, $3.

Reviewed by P. B. McDonald
Assistant Professor of English, New York University

In view of the increased interest in the history of science, and the establishment of courses in it at Massachusetts Institute of Technology, Columbia University, Harvard University, New York University, etc., any book on the subject is worthy of attention. Consequently this volume of over 400 pages giving summaries of the lives of over 200 famous scientists deserves sympathetic consideration.

It must be confessed, however, that the author has not done an especially good job. He has attempted to sketch biographically the development of science from Thales and Pythagoras down to Einstein and Edison. His apportionment of space to individual scientists is not commendable, nor does his investigation show any striking qualities.

Such important scientists as Priestley, Cavendish, Archimedes, Cardan, and Davy are allotted less than two pages each, while Tycho Brahe gets nearly six pages and Avogardo gets nearly four pages. Among more modern celebrities, Gibbs, who is sometimes called America's greatest scientist, receives less space than such comparatively minor figures as Bragg, Boltzmann, or Michel-Levy; and Joseph Henry receives less space than Henry Rowland.

But of more consequence still, the analysis of individual scientists is not inspiring. Encyclopedic facts are stated baldly, and little if any advance is made over an ordinary encyclopedia article. The biography of Lavoisier, for example, is unsatisfactory, as is also that of Darwin.

Among the good points of the book are its inclusiveness and its implication of the unity of science. Many of the biographies of scientists still alive or only recently dead are valuable because such information is not easy to find in reference books. The author is at his best in interpreting the lives of such scientists as Marconi, Edison, and Steinmetz.

Ammonia Distillation in Gas Works

THE DESIGN AND WORKING OF AMMONIA STILLS. By *P. Parrish*, manager South Metropolitan Gas Co. 300 pages. D. Van Nostrand Co., New York. Price, $10.

Reviewed by F. W. Sperr, Jr.
Chief Chemist, The Koppers Company

The reader should not expect to find this a complete treatise on the production of ammonia. The book is written almost exclusively from the standpoint of gas works practice and the titles of some of the chapters, e.g., "The Production of Steam from Low Grade Fuel"; "The Treatment of Effluent Liquor and the Disposal of the Sludge"; "The Use of Concentrated Ammonia Liquor in the Purification of Crude Coal Gas"; and "Considerations Governing the Price of Gas Liquor" are significant in this connection. There is a very short chapter on "Ammonia Stills and the Ammonia-Soda Process" but the conditions necessary for the manufacture of pure aqua ammonia are given scant attention.

The scope of the book is still further limited by the fact that the author ignores altogether the relation of ammonia distillation to byproduct coke oven operation. This is an important consideration for the American reader because the bulk of the ammonia and ammonia compounds produced in this country is derived from byproduct coke ovens, and so extensive is the use of byproduct coke ovens for gas manufacture in America and so widespread is the application of the direct process of ammonia recovery, that ammonia distillation for more than 90 per cent of the total production is a comparatively simple and well standardized proposition.

In stating these limitations no criticism is intended because an author is entitled to choose the scope of his own work; but the reader would gain a clearer conception of this scope had the book borne some such title as "Ammonia Distillation in British Gas Works Practice." As thus defined, this work of Mr. Parrish is most interesting and useful and will occupy a valuable place in our technical literature.

As something has been said about the limitations of the work, something should also be said about certain valuable features, that the reader would not naturally expect to find. The first of these is a chapter on the production of steam from low-grade fuel, including a discussion of the softening and purification of boiler feed water; another, is a chapter on the treatment of effluent liquor and the disposal of the sludge, which the reviewer regards as the best discussion of this important subject that has so far been written. The disposal of ammonia still waste is coming to be a serious matter in many American plants and careful attention should be given to the practical methods that have been developed in England.

In the heart of the book, devoted to problems affecting distillation and dissociation, to the design of ammonia stills, and to the design of dephlegmators, coolers, heat interchangers and liming plant, one is impressed by the author's appreciation of the value of theoretical principles and also by his appreciation of the desirability of standardization. Contemplating the many types of ammonia stills now used in England, he writes "One is led, almost irresistibly, to the conclusion that standardization based on experimental data under varying conditions, and with due regard to the fundamental laws governing the distillation of gas liquor, would be fully warranted." He shows in tabulated data "the confusion of types and dimensions which has arisen," the obvious inference being "that all these stills cannot alike be efficient and economical." In American byproduct coke plant practice, much progress has been made in the standardization of the ammonia distillation equipment and it would be very desirable for the gas industry to aim at a similar degree of standardization.

The book is well illustrated and the clearness of the many apparatus drawings is very gratifying. The volume is a somewhat bulky one and much could have been saved in size and weight by cutting down the unnecessarily wide margin, but this is really a very minor criticism in comparison with the many merits of the book. As Dr. Charles C. Carpenter indicates in the foreword, the phraseology of the author is somewhat rugged and lacking in the polish which is usually characteristic of British writers. The book is essentially one of facts and these facts are well and clearly stated.

Beginning with this issue, there will be a monthly readers' guide in some phase of either chemical engineering unit operation or chemical industry. These summaries will be prepared by various specialists in their respective fields.

Books on Petroleum

A Readers Guide on the Various Phases of the Petroleum Industry

By George Calingaert

Chemical Engineering Department Massachusetts Institute of Technology

THE object of the present review is not to discuss the value of all the books that have been published on this subject, but merely to guide the prospective reader in his choice of suitable reading matter.

I—TREATISES

Engler, "Höfer das Erdöl," 5 vols., Leipzic, 1909-1919—Covers the whole field of petroleum science with carefully compiled references to original articles. The main subtitles are: Chemistry and physics, geology, winning, transportation, technology, testing, uses and economy. Not quite up to date on the characteristics of the American oil fields, but constitutes a valuable book of reference.

B. Redwood, "A Treatise on Petroleum," 3 vols., London, 1922—Not quite so complete as Engler but contains good documentation and is easy reading. The three books comprise: History, geology and properties; production, refining, distribution; testing, uses, regulations and statistics. Both books are probably too detailed for continuous reading, but should find their place in all petroleum libraries.

II—GENERAL INFORMATION

The books mentioned under this heading are divisible into two classes: (1) Books which will be of value in familiarizing the layman with the subject and yet contain enough specific information to be of help to the professional; (2) books more especially written for those who are already familiar with the subject. This specification should, however, not be considered too rigid.

A. E. Dunstan, "The Petroleum Industry," London, 1923—A series of lectures given at the Petroleum Exhibition in London, 1920. Gives an elementary description of the various phases of petroleum technology, outlining the principal methods used, but without any details about the underlying principles.

Tinker & Challenger, "Chemistry of Petroleum," Appleton, New York, 1921—A good outline of the scientific principles underlying petroleum technology, a simple description of the chemistry and physical chemistry involved, together with methods of testing. Petroleum technology is not considered.

W. H. Emmons, "Geology of Petroleum," McGraw-Hill, 1921—A complete and easy reading survey of the geology of petroleum. Embraces the general conditions of occurrence of oil, surface indications and structural features, as well as a specific study of the various American and foreign pools.

L. C. Uren, "Petroleum Production Engineering," McGraw-Hill, 1924—Altogether a textbook, a book of introduction and of reference. Contains enough specific information to be of great use to the worker in the field. Restricted, as implied, to prospecting, drilling and transportation, but covers those subjects thoroughly.

Bacon and Hamor, "American Petroleum Industry," 2 vols., McGraw-Hill, 1923—Covers the whole subject thoroughly, giving more consideration to the technical and economic side of the oil business than to theoretical studies.

E. H Leslie, "Automotive Fuels," Chemical Catalog Co., 1923—A thoroughly developed and yet easy reading book. The theoretical principles involved are explained clearly. The chapters on "Fractional Distillation" and "Cracking" are especially well presented. The book comprises also refining, chemical treatment, natural gas gasoline, and methods of testing.

C. Ellis and J. V. Meigs, "Gasoline and Motor Fuels," Van Nostrand, 1921—Less developed on the theoretical principles and complete on their technical realization in practice, with a good description of the plant equipment used in the various cracking processes. Discusses also carefully the various requirements for motor fuels and the methods of testing.

A. Campbell, "Petroleum Refining," London, 1922, *H. S. Bell,* "Petroleum Refining," 1923—Respectively, an English and an American book on the subject. Useful technical guides to the refiner, containing detailed specifications on equipment, but no theoretical discussion.

III—TESTING AND SPECIFICATIONS

W. A. Hamor and F. W. Padgett, "The Technical Examination of Crude Petroleum, Petroleum Production and Natural Gas," McGraw-Hill, 1920—May be taken as a laboratory supplement to "Bacon and Hamor." Gives methods of testing with specification and construction of testing equipment. In Appendix, such useful information as conversion and correction tables, specifications, regulations, etc.

Department of the Interior, "Specifications for Petroleum Production and Methods of Testing," Tech. Paper No. 323—Gives both the U. S. Government specifications and methods of testing.

Institute of Petroleum Technologists, "Standard Methods of Testing Petroleum and its Products," 1924—The British publication corresponding to the preceding American one.

IV—HANDBOOKS

D. T. Day, "Handbook of the Petroleum Industry," John Wiley, 1922—Contains short discussions of the processes and properties. Gives detailed and carefully compiled specifications on production and equipment. Useful for engineers in the field, but not descriptive enough to serve as an introduction.

R. Cross, "Handbook of Petroleum, Asphalt and Natural Gas," Kansas City Testing Laboratory, 1922—Useful only to one already familiar with the subject.

Revised Edition of Thompson's Work on Applied Electrochemistry

THEORETICAL AND APPLIED ELECTROCHEMISTRY, revised edition. By *Maurice de Kay Thompson*, associate professor of electrochemistry, Massachusetts Institute of Technology. The Macmillan Co., New York. Price, $4.50.

Progress in the theory and practice of electrochemistry has been so rapid in the last decade, that text and reference books on this subject have lagged far behind. Thompson's revision of his first work is practically a new contribution, so great has been the expansion of subject matter. The inclusion of fundamental theory has increased its usefulness as a text, and the author's careful survey of recent periodical literature makes the book a reference work of the highest order.

About one-third of the book is concerned with theory. Faraday's Law, the Electrolytic Dissociation Theory and Migration of Irons, Electrical Conductance, Electrochemistry of Colloids, Electromotive Force, Cathodic Processes, Anodic Processes, Electrolytic Reduction and Electrolytic Oxidation are the main sub-divisions that are discussed theoretically.

There is room for improvement in the practical arrangement of material, and in the relative space allotted to various industrial applications. For example, in Chapter VIII, a whole page is given to clay diaphragms, but asbestos diaphragms are neglected. Diaphragms and other materials of electrolytic cell construction must, of necessity, be discussed in connection with specific applications, and for this reason, the usefulness of a short separate chapter on this subject is questioned. In Chapter IX on electroplating, electrotyping and production of metallic objects, nickel plating deserves more space. Chapter XII, on the electrolysis of alkali halides, is well written and complete. The inclusion of a theoretical discussion and operating curves is a commendable feature. Chapters XIV and XV on primary cells and storage cells respectively, remain essentially the same, as no recent change of fundamental importance has occurred in this branch of applied electrochemistry.

The economic importance of electric furnace industries justify the prominence that they occupy in this book. After describing the characteristics of the arc, resistance and induction furnaces, the author discusses the efficiency of electric furnaces, principles of furnace design, choice of lining material, design of electrodes, and regulation of temperature. Laboratory furnaces are described also.

The industrial technology of calcium carbide, carborundum, silicon oxy-carbides, graphite, silicon, carbon bisulphide, phosphorus, fused aluminum and magnesium oxide, fused quartz and fused salts, is treated in a thorough way. Of the metals produced by the electroysis of fused salts, aluminum, sodium, potassium, calcium, and magnesium, are the most important industrially.

Chapter XIX, on the electrothermic reduction of metallic oxides, steel refining and brass melting is an excellent feature of the book. Beginning with a brief outline of the older method of reducing iron ores, the author describes the furnaces of Stassano, Herault, and Keller. Reactions, operating conditions and economics are considered. The book concludes with chapters on the fixation of atmospheric nitrogen and on the production of ozone. CHAPLIN TYLER.

Materials of Construction

ACID-RESISTING METALS. By *Sydney J. Tungay*. 136 pages. Ernest Benn, Ltd., London. Price 6s.

Problems involving the selection of proper materials of chemical plant construction are almost the every-day diet of the plant engineers. Hence any help in the solution of those problems is to be welcomed. Tungay's book is by no means the first in this field—in fact too much literature of an unreliable, inaccurate or qualitative nature has been printed, in addition to the number of meritorious books on materials of construction and corrosion. The author discusses the properties and applications of high silicon iron, lead, aluminum, stainless steels, monel metal, cast iron and steel, nickel and chromium alloys and copper and copper alloys. The text is arranged logically and can be read easily by the general engineer not having a profound chemical knowledge. The book is one that should win widespread approval.

Dust Explosions

THE DUST HAZARD IN INDUSTRY. By *William E. Gibbs*, chief chemist, The Salt Union, Ltd., Liverpool. 168 pages. Ernest Benn, Ltd., London. Price, 6s.

In recent years, dust explosions have occurred with alarming frequency, and almost invariably each disaster has resulted in serious loss of life and property. In this book, the author has made available a wealth of information obtained from the most reliable sources, such as the investigations of the U. S. Bureau of Mines. Bureau of Chemistry, Department of Agriculture and the British Home Office. The subject is developed on a theoretical basis, but at the same time the style is easy to follow. The chapter headings include the subjects of occupational diseases due to dust, explosive combustion, explosive dusts, dust explosions, industrial explosions and dust explosions in mines. In view of the breadth of treatment and general excellence, this book should be read by every engineer having contact with dust hazards, past or potential.

Freundlich Writes Elementary Colloid Text

THE ELEMENTS OF COLLOIDAL CHEMISTRY. By *Herbert Freundlich*, fellow of the Kaiser Wilhelm Institute of physical chemistry and electrochemistry, honorary professor in the University of Berlin; translated by *George Barger*, professor of medical chemistry, University of Edinburgh. 210 pages. E. P. Dutton and Co., New York. Price, $3.

Considering the extremely broad application of colloid chemistry to industry, there is room for several books on the fundamentals of this rapidly growing branch of science. Freundlich's book is a welcome addition to the literature, and because of its non-mathematical method of treatment, it makes a particularly good introductory text. The text material is logically divided according to the principal colloidal systems, that is, capillary chemistry, or a study of interfaces; solutions, or sols and gels; and colloidals disperse structures such as mists and smokes, foams, and multi-phase systems.

Pregl's Quantitative Organic Micro-analysis

The review of Prebl's "Quantitative Organic Microanalysis" in our Feb. 9, 1925, issue, p. 250, omitted to state that the book is published by P. Blakiston's Son & Co., Philadelphia, Pa., and that the price is $4.00.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Confirms Results of Bahlke and Wilson

To the Editor of Chem. & Met.:

Sir—With reference to the discussion taking place in your journal as to the temperature of vapor rising from boiling salt solutions, my associate, R. S. Piroomov, and I have carried out a series of experiments completely confirming the results reported by Wilson and Bahlke. To avoid temperature changes we employed a boiling, saturated solution of sodium chloride. The major part of the vapor went up outside a jacket and the rest up through an inner tube containing the thermometer. Like Wilson and Bahlke we found that at the start steam condensed on the thermometer bulb, that this condensed steam evaporated very slowly indeed so that the thermometer read 100 deg. for a long time but that finally this drop of water disappeared and then the thermometer bulb rose slowly to within about 1 deg. of the boiling salt solution. Since there was radiation loss through the glass wall of the jacket to the outside, the thermometer could not possibly come up to the temperature of the vapor.

Unlike Wilson and Bahlke, we found a great deal of difficulty in completely eliminating entrainment, particularly when using sensitive chemical tests to detect it. On the other hand, three layers of fine copper gauze in the bottom of the inner tube reduced it to a negligible point. We used a metal container for the boiling liquid and asbestos sheet out beyond its edges so that radiation from the flame was completely eliminated.

Since the radiation effect makes the reading of the thermometer too low, it follows that our experimental results are absolutely incompatible with a temperature of 100 deg. for the water vapor leaving the solution. Furthermore, there seems no reason to doubt that the small temperature difference between the boiling solution and the thermometer in the vapor space is due to the radiation error and not to low temperature of the vapor. Isothermal jacketing of the vapor space at the temperature of the boiling solution will make the thermometer read correctly, but we did not do this in order to avoid all possibility of having the thermometer temperature raised by radiation from the jacket.

Cambridge, Mass. W. K. LEWIS.

Badger Makes Position Clear

To the Editor of Chem. & Met.:

Sir—It might not be obvious from my letter as printed in your Feb. 23 number, that I had not seen Wilson's article when I wrote the letter. My discussion was based largely on Harker's paper which you forwarded me, but which was not published in *Chem. & Met.*

Before proceeding further I think I should define my own position. In this argument I am entirely an outsider, who takes considerable interest in watching the fight and likes to stir it up once in a while when it begins to get slow, but who does not care in the least which side wins. In the design of multiple-effect evaporators, it is of no consequence at all as to whether the steam is saturated or superheated, Mr. Wilson to the contrary notwithstanding. In either case we lose from our available temperature drop the rise in boiling point of the solution. The amount of heat due to superheat if the vapor is superheated, is so small in proportion to the total, in any case I have ever handled in practice, that it is usually lost by radiation from the vapor piping, and is too small to take into account in the design in any case.

I should also make it plain that in the translation of Schreber's article there were only two sentences of my own. One stated that Schreber's was the most carefully worked out apparatus which had yet been described; the other makes a criticism of a thermodynamic argument of Schreber's. In the article as printed it was not clear where my own comments ended.

It seems to me that Mr. Wilson has the best of it in this round, although I will not admit that Schreber is down for the count yet. Wilson's ideal cycle, in which he shows that if the vapor were saturated a perpetual motion machine would be possible, seems to me the most convincing argument yet advanced from the standpoint of thermodynamics. At the same time, before this matter is finally settled, it seems to me that two things remain to be done. First, to prove definitely that Schreber was in error; and second, to prove definitely that the temperature of the vapor is exactly that of the solution.

It is true that Wilson's experiments show beyond a doubt that the vapor contains some superheat, but in the interests of a final proof of the argument, I would like to see someone build an apparatus in which the temperature of the measuring device in the vapor space would always read exactly the same temperature as the boiling solution.

If in publishing Schreber's article I have stirred up a controversy to such an extent as to call forth such a paper as Mr. Wilson's, I feel that I have made a distinct contribution; even though Schreber may be proved later to have been in error. W. L. BADGER.

Ann Arbor, Mich.

Temperature of Vapor in Evaporators

To the Editor of Chem. & Met.:

Sir—Your issue of Feb. 23 carries a discussion of an article by K. Schreber on the "Temperature of Vapor Above Boiling Salt Solution." I desire to contribute to the discussion, having information obtained while carrying on experimental work with an evaporator.

Some time ago I had a series of careful tests made on a special evaporator concentrating caustic soda solutions to high density. The object of the tests was to determine heat transfer coefficients. The concentration was carried to 75 per cent NaOH, although on two runs solution was concentrated to 80 per cent, and on one run to 83 per cent. During these tests frequent readings were made of steam pressure and vacuum, and of the temperatures of steam, solution and vapor.

Vapor was superheated at all times, this superheat

rising consistently with the rise in concentration and boiling point of the solution. Numerous readings were made with vapor having superheat of 120 deg. F.

Apparatus was of commercial size, having sufficient capacity for a daily output of 50 tons solid caustic. Steam was used at 125-lb. gage pressure and a vacuum of 26 in. was maintained. Evaporator was provided with a highly efficient centrifugal separator and there was no entrained liquid in the vapor at the point where its temperature was determined. This statement is based on the fact that no caustic could be detected in tail water from condenser. When the concentration reached 75 per cent, temperature difference between steam and liquid reached a low value and the boiling was very slow. Under these circumstances there could be no appreciable entrainment in an evaporator having adequate vapor space.

I have often observed the high temperature of water vapor from solutions having high boiling points, such as caustic soda, caustic potash, and zinc chloride, and believe the vapor is always superheated to the degree that the boiling temperature of the solution exceeds that of water under the same conditions of pressure or vacuum.

B. S. HUGHES.

Buffalo, N. Y.

Powdered Coal Has Advantages

To the Editor of Chem. & Met.:

Sir—In an article entitled "Coal as an Industrial Fuel" by D. J. Demorest, professor of metallurgy at the Ohio State University, there are several statements that are very misleading and the writer desires to point them out to the readers in order to correct any wrong impression that might be formed regarding the advantakes in the use of powdered coal.

The first statement made by Mr. Demorest in regard to powdered coal is not warranted by actual facts—namely, "that it costs considerable to prepare the coal in the powdered condition." John Anderson of Milwaukee, who has during the past 5 years pulverized more than a million and a half tons of coal, says that the cost of pulverizing is as follows:

	Cost Per Ton
Labor	$0.143
Drying coal at $4 plus electric energy	.119
Lubrication at 9c. per lb.	.007
Maintenance—labor	.036
Maintenance—material	.020
Total cost	$0.325

Another cost in a company having a daily output of 100 tons is reported by June (*Dodge Idea*, 1922, July):

	Cost Per Ton
Labor	$0.176
Repairs	.19
Power	.134
Drier Coal	.022
Total cost	$0.522

In an article by Scheffler (*Iron Age*, 1920, June), the following data are given: "One plant burned 36,682 tons of coal per annum, and the cost, including labor, operating material, repairs to all machinery, power for operating the mill, conveyors, etc., and delivering the coal to the point at which it is to be fired, amounted to $0.3148 per ton. At "another plant burning 63,016 tons of coal per annum, the costs amounted to $0.2733 per ton."

N. C. Harrison in his paper on "Powdered Coal as a Fuel," read before the Society of Mechanical Engineers in June, 1919, gives the following actual operating costs per net ton at the Atlantic Steel Co. plant, in which the daily output was 80 tons per day:

	Cost Per Ton
Labor	$0.22
Repairs	.19
Power	.134
Drier coal	.122
Total cost	$0.666

In discussing the "only advantages of powdered coal firing of steam plants over stoker firing," Mr. Demorest states: "It is possible to burn powdered coal with a very low excess of air and still get complete combustion. This results in a minimum loss of heat up the chimney, increased boiler capacity and higher fuel efficiency. It is easy to regulate the rate of firing to the fluctuations of the demand for steam."

In outlining these as the "only" advantages, has not Mr. Demorest told a good deal in its favor? What more or better advantages could he expect, and yet he has not told the whole story by any means. He could add that the maintenance and upkeep of the powdered coal equipment is less than that of stokers. He could also add that cheaper coals can be used in powdered coal firing than can be used with stokers. And, inasmuch as his article deals with the use of coal as an industrial fuel, it seems strange that no mention was made of the fact that poor grades of coal could be used in pulverized form. This has been proven at the Cahokia plant at East St. Louis where a comparative test was made between stokers and pulverized coal, and the result was a decision in favor of powdered coal.

Mr. Demorest in his article particularly calls attention to what he terms "the greatest drawback to the use of powdered coal in steam power plants is the ash trouble." This statement is unquestionably not borne out by facts. In all truth it can be said that the disposal of ash is one of the least of the troubles of the powdered coal operator. Henry Ford has burned in the past 4 years at least 200,000 tons of coal in his pulverized fired steam plant at River Rouge using coal having an average ash content of 8 per cent, or 16,000 tons of ash as fired. About 2 per cent of this amount was deposited in the combustion chamber or ash hopper, and the remainder, about 15,000 tons of ash, went up the chimney and floated away. Efforts have been made to locate this ash within a radius of 12 miles from this plant without success.

Would the Cleveland Illuminating Co. of Cleveland, Ohio, after operating for more than a year a powdered coal plant located in a thickly settled residence district, build another plant to burn powdered coal in a similar location, if there were even a remote possibility of a lawsuit arising over the disposal of ashes?

Would the city council of Detroit, Mich., have withdrawn its objections to the construction of a powdered coal plant for the municipal operated street railways, which plant is to be built in the heart of the city, if it had not fully investigated the results of similar plants in other localities and been fully convinced that the ash trouble was no "drawback"?

The writer's desk is located about midway between two powdered coal plants on steam boilers, the plants not being over one mile apart, which have been in operation for more than a year. With windows wide

open no trace of ashes has been discovered, either inside or on the window sills. One of these is the largest single boiler installation in the United States.

Mr. Demorest also raises a point that is rather a delicate question, when he says that it is "doubtful" to him of the economy of a powdered coal installation over that of a stoker. It is true that every man has a right to have an opinion and to express such an opinion; but when 75 per cent of the largest and most modern steam plants constructed during the past 30 months have without a doubt fully investigated the advantages and disadvantages of powdered coal firing as compared with stoker firing and the decision reached was to install a powdered coal plant instead of a stoker plant, can all of these engineers who were interested in one thing only, namely, to give their employers the best that could be purchased, be wrong in their findings?

As to the question of operating a powdered coal plant against that of operating a stoker fired plant: There are many figures available to prove that whereas a stoker fired plant may be cheaper as a first cost proposition than a powdered coal plant, the cost of operating a powdered coal plant is so materially reduced that this first cost is offset in a short time. C. F. HERINGTON.

Pittsburgh, Pa.

Tunnel Kiln Designed by Ekstrand

To the Editor of Chem. & Met.:

Sir—The description of the tunnel kiln at the Vitrefrax Co. plant in your issue of Nov. 17 is very good and is appreciated.

A correction is due, however, as the writer designed and built this kiln, not "the engineering department."

Los Angeles, Calif. E. W. EKSTRAND.

Obtaining Painting Specifications

To the Editor of Chem. & Met.:

Sir—There appears to be an inaccuracy or unintentional misstatement in a notice appearing in the Feb. 23 issue, page 337, under the caption "Painting Specifications Recommended." The last sentence states that the numerous specifications referred to in the text are also available to those interested on application at the bureau.

Application to the bureau brings word from Dr. Burgess that neither Technological Paper 274 nor the specifications are available except through the Government Printing Office. This is not perhaps of great importance, but will no doubt result in some lost motion both on the part of individuals desiring these publications and on the part of the Bureau of Standards.

Naugatuck, Conn. W. R. BEAN.

Anti-Freeze Solutions

To the Editor of Chem. & Met.

Sir—Several articles written on the subject of antifreeze mixtures for outomobile radiators have concluded with such a degree of finality as to leave the impression that there are no such mixtures that can compare with alcohol and water.

For three seasons the writer has been using a solution of glycerine and water, made up by mixing equal volumes of crude 80 per cent glycerol and pure water, with a degree of satisfaction that precludes the thought of using any alcohol at all. On account of its low boiling point, 172 deg. F., alcohol is continually evaporating from a luke-warm radiator solution with consequent lowering of the resistance to freezing. The freezing point becomes problematical, and, if the radiator fluid is not tested daily, disastrous results follow. Glycerine, on the other hand, has a boiling point of 554 deg. F., and the loss by evaporation is due only to water. A mixture of glycerine and water prepared as above (50 per cent by volume) stands a temperature of 35 below zero without any difficulty. Actual tests on such a solution at 40 below zero failed to indicate the least sign of freezing. This strength is recommended for city driving where a car is parked most of the time in extreme cold. For long drives a 25 per cent solution is best and yet safe for 5 below zero.

Three stock complaints from the use of glycerine are that it overheats, smells, and sometimes it foams. Investigation of a few cases revealed that in one a radiator was dirty and clogged, in another a fan belt was slipping, a third had a faulty pump and a fourth had leaks all over the cooling system. If a car is in proper working order none of the above difficulties will be encountered.

The knowledge that your glycerine is always there while alcohol may or may not be present in your radiator is a mental tonic that average motorists would not trade for gray hairs. The effect on the purse is interesting. Three gallons of 50 per cent glycerine solution cost about \$3. Three gallons of alcohol cost \$2. The glycerine last all winter. and may be used each season if none is lost by filtering through a cloth to remove rust and lime. The alcohol starts to evaporate as soon as the car is used, and to make up for evaporation about a gallon a month is added. If the cold weather continues for five months the added cost is about \$3.25 making a total of \$5.25 against \$3. At the end of the season the alcoholic mixture is drained from the car and the next season starts with fresh alcohol, while the same glycerine can be used indefinitely from year to year. F. E. JOYCE.

Sioux City, Iowa.

Credit Research Laboratory

To the Editor of Chem. & Met.:

Sir—The article entitled "Cost of Atomizing Fuel Oil" (*Chem. & Met.*, 1925, Vol., 32, p. 323) neglected to state that the article was a contribution from the Research Laboratory of Applied Chemistry, Mass. Institute of Technology. CHAPLIN TYLER.

New York City.

Producing Citrus Pectin

The simple method used for making apple pectin cannot be used for making citrus pectin. Department Bulletin No. 1,323, Citrus Pectin, by H. D. Poore, of the Bureau of Chemistry, gives the results of an investigation to determine the properties of citrus pectin and to devise a method for its production on a commercial scale. Results of previous work in this field are given, together with a very comprehensive bibliography.

The best method of extracting citrus pectin was found to be to heat the finely ground peel or residue with acidified water, clarifying the expressed extract with kieselguhr. The bitter principle was removed with alcohol from powdered pectin prepared from concentrated solutions of pectin in the laboratory and in a commercial plant.

Chemical Engineering Patents

Review of Recent Inventions Relating to Clarification, Combustion, Distillation, Fluid Flow, Mixing and Pulverizing

Distillation of Solid Fuel—R. De Bartolomeis has invented a process of distilling solid fuels such as coal, lignite, peat and wood to obtain gaseous products. The charge of fuel is distilled as it descends a vertical retort, heat being supplied by inert gas passing upwards through the mass of incandescent residue of distillation in the lower portion of the retort. The gases of combustion are a sufficient source of heat, and the ratio of the heating zone to the total charge, may be governed by the amount of air admitted to the retort base. No. 1,524,784 issued Feb. 3, 1925.

Method of Measuring the Flow of Fluids — H. N. Packard has assigned to the Cutler-Hammer Mfg. Co. a method of and apparatus for measuring the rate of flow of fluids. Measurement of the rate of flow of fluids has been accomplished by imparting heat to the fluid and determining the temperature effect of the heat transfer on the fluid. In the usual form of flow-meter, heat is supplied by an electric resistance heater placed between the two orifices. In the present invention, the electric heater is replaced by a fluid containing coil that can either supply heat to, or remove heat from, the main body of fluid. Thermometers at the entrance and exit ends of the coil show the rate of heat transfer between the coil and the fluid to be measured, regardless of the direction of heat transfer. Valves control the rate of flow of fluid through the coil. As in the electric resistance type of flow-meter, the rate of flow of fluid can be measured either by variations in the ratio of the pressure drops, the rate of heat transfer being maintained constant, or by measurement of the rate of heat transfer required to maintain a constant ratio between the pressure drops. No. 1,525,463 issued Feb. 10, 1925.

Apparatus for Mixing Viscous Materials—F. A. Browne has assigned to the Barber Asphalt Co. a mixing apparatus that is adapted particularly to mixing materials used in the manufacture of roofing. The container is a jacketed horizontal cylinder that may be steam heated. Extending axially through the cylinder is a shaft upon which are mounted paddles at short intervals. The paddles tend to direct the material toward the center of the cylinder, and the mixing process may be made continuous by feeding under pressure. Short circuiting of the mixture is prevented by a discharge pipe that extends upward and into the cylinder. The tendency of the mixture to work into the stuffing boxes of the shaft is opposed by propellers that rotate counter to the agitating paddles. No. 1,524,854 issued Feb. 3. 1925.

Clarification Process and Apparatus — H. Ahlqvist describes a classification process and apparatus that can be used on any liquor containing suspended solids, particularly those in the paper industry. The apparatus is a modified conical containing vessel provided with a serrated upper edge, over which the feed liquor is distributed as it comes from the launder. The mud settles out along the side walls and is discharged from the bottom by slowly rotating scraper blades, but the liquor reverses in direction of flow after depositing the mud, and passes up through a central bell-shaped separator and out of a discharge pipe at the top. Thus the feed liquor and clear discharge liquor are separated effectually. No. 1,526,197 issued Feb. 10, 1925.

Pulverizer for Coal—J. Molz has assigned to the Babcock & Wilcox Co. a pulverizer designed especially for making powdered coal. In this machine, grinding is accomplished by a series of impact elements attached to disks mounted on a central rotating shaft. The important features are a jacketed casing and a number of adjustable air registers in this casing. The entire machine may be heated by passing air through the jacket, and the air passing into the grinding chamber preheats the fuel and dries it to any desired degree, all in one step. As a result, the coal is dried to such an extent that it can be efficiently pulverized, and caking of damp coal is prevented. No. 1,526,077 issued Feb. 10, 1925.

Non-Caking Calcium Chloride — P. Cottringer and W. R. Collings have assigned to the Dow Chemical Co. a process for making non-caking metallic chlorides, in flake form. The patent refers particularly to calcium chloride, as this compound is the most hygroscopic of the common metallic chlorides. Molten chloride is run into a pan, and is picked up by a cooled rotating drum that dips into the liquid. The layer of chloride is removed by a doctor blade, and passes through an internally fired rotary kiln the hot end of which is from 400 to 475 deg. C. The product leaves the kiln at 150 deg. C., and to prevent sweating, it is then cooled to approximately 100 deg. C., at which temperature it is packaged in a flaky condition. The inventors say that the product will not harden or cake under ordinary conditions of storage in metal drums, or even in bags, as the superficial dehydration during the process effectively prevents that tendency. No. 1,527,121 issued Feb. 17, 1925.

Making Alcohol-Ether Mixtures—F. E. Lichtenthaeler has invented a process for making alcohol-ether mixtures directly from raw material containing sugars or starches. The object of combining the two processes is to avoid a separate denaturing operation, and also the expense of separate mixing of ether and alcohol. The apparatus consists of an ordinary alcohol still, part of the product from which is bypassed to an ether generator of the usual type. The ether vapor from the generator is absorbed by the hot condensed alcohol, or is condensed and is mixed directly with the alcohol. The proportion of ether is regulated by the amount of alcohol fed to the ether generator. The whole system is closed, and provision is made for the return of the undecomposed alcohol from the ether generator to the alcohol still. No. 1,527,-144 issued Feb. 17, 1925.

Furnace for Pulverized Fuel — C. F. Miller has assigned to the Westinghouse Electric & Mfg. Co. a method of and apparatus for burning pulverized fuel. Powdered fuel and air are introduced into the firebox of the furnace in the form of a thin sheet, horizontal to the slag surfaces, causing the molten slag surface to be enveloped in a thin sheet of flame, thereby increasing the rate of heat transfer between the flame and the slag surface and insuring a more complete removal of dust particles from the gaseous products of combustion. The design of the furnace is such that the flame is deflected from the slag surface to spread and eddy against other slag surfaces, thus tending to remove the dust particles. No. 1,526,756 issued Feb. 17, 1925.

The Plant Notebook

An Exchange for Operating Men

Editor's Note: With this issue, The Plant Notebook becomes a regular monthly department of "Chem. & Met." It will serve as an exchange to which men in charge of operation and production in the Chemical Engineering Industries can bring special methods and shortcuts that they have worked out, to the profit of those who encounter problems similar to theirs; and from which they in turn can take much that can be put to profitable use on their own jobs. It will be only through the generous response of our readers in contributions that this department can fulfill its promise of help to all. We are confident that this response will be forthcoming.

Fig. 1—Chute Used With Bag Counter
This view shows a bag passing over the slotted part of the chute and about to encounter the prongs

Accurate Device for Counting Bags of Material

In the plant of the California and Hawaiian Sugar Refining Corp., described elsewhere in this issue, there has been developed an ingenious electrical counter for enumerating the bags entering and leaving the refinery. In this device a light steel shaft is held in bearings underneath the chute in which the bags of sugar, raw or refined, pass, as shown in Fig. 1.

The bottom of the chute is slotted to allow the free movement of several steel rods that project at a slight angle away from the moving bags and are connected with the shaft as are the prongs to the heel of a fork. At each end of the shaft a cam connection operates a moveable rod, at the point of which is the edge of a knife switch, as shown in Figs. 2 and 3. Contact is made whenever this switch rod is raised by the action of the cam, movement of which occurs when the prongs of the counter are depressed by the passage of a bag.

A strong spring is arranged to keep the moveable element of the switch out of contact under no-load conditions; delicate adjustment is necessary, but practicable, to insure the registration of each bag when several follow in close sequence. The counter works satisfactorily, even if no definite space exists between bags, the slight upward movement of the forks at the edge of one bag being sufficient to break contact, to be followed by sufficient depression, caused by the weight of the next bag, to avoid a "miss." Arcing across contacts must be avoided, otherwise an overcount will result.

The passage of bags past any given point is checked by two of such switches, one on each side of the chute, the accuracy of the system being evidenced by the exceptionally close uniformity of result obtained. Each switch, using 120 volts, d.c., is connected by cable to a main instrument board, on which the electric counters, in duplicate, are mounted as shown in Fig. 4. The ease of control is a point in favor of this system, as compared with the use of a mechanical device, which can be made to register only at or near the place of operation. In a plant of the size of the one at Crockett it is necessary to place such registering units at long distances apart.

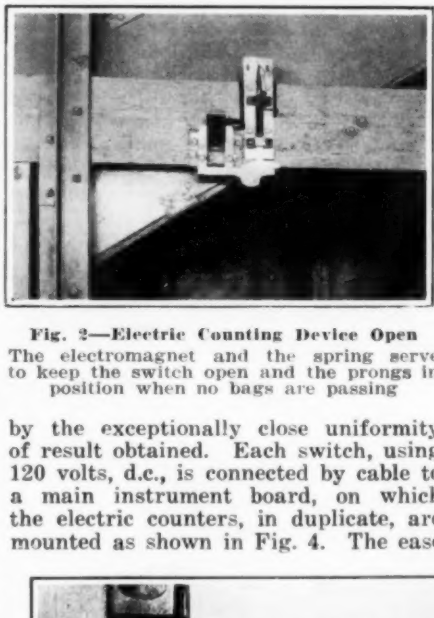


Fig. 2—Electric Counting Device Open
The electromagnet and the spring serve to keep the switch open and the prongs in position when no bags are passing

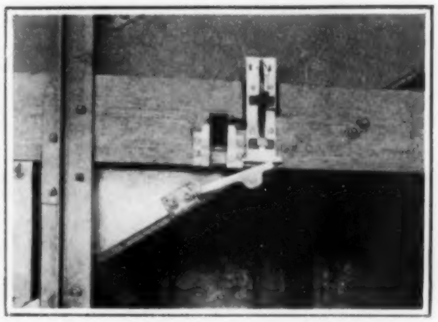


Fig. 3—Electric Counting Device Closed
When a passing bag depresses the prongs the arm is forced from the poles of the magnet, the spring compressed and the circuit closed

Decreasing Maximum Demand Lessens Power Cost

By W. J. Risley, Jr.
North Glenside, Pa.

The demand charge in a power bill may run from 20 per cent to as high as 75 per cent of the amount of the bill. It may not always be labeled as such, but it is there just the same. As an example of what is meant by this, suppose you turned on every light and electric appliance in your house at once. The sum total of the current demand by each of these units is your maximum demand. The electric company must be prepared to furnish this

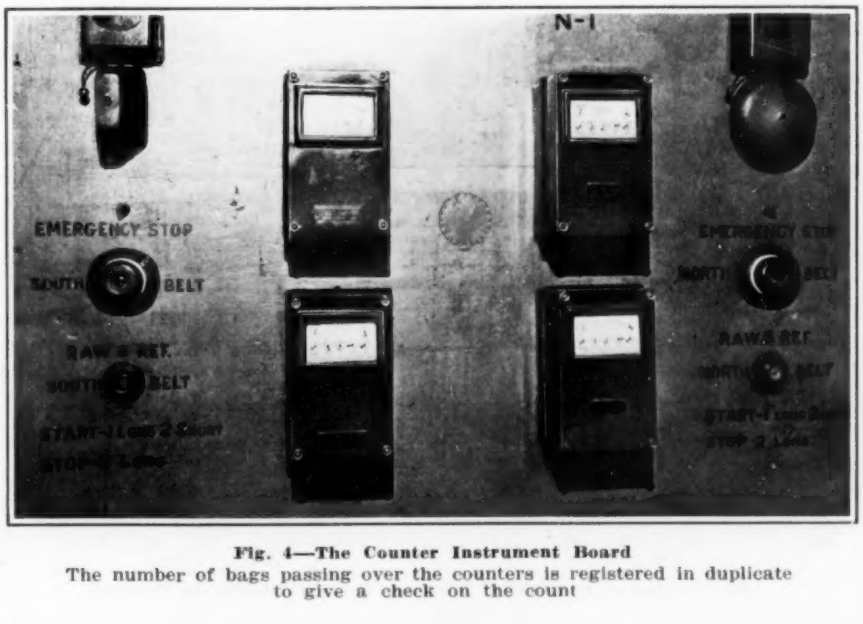


Fig. 4—The Counter Instrument Board
The number of bags passing over the counters is registered in duplicate to give a check on the count

amount of electricity to you and to all other of its consumers at the same time. That load constitutes the maximum demand on their plant.

Of course, all these individual maxi-

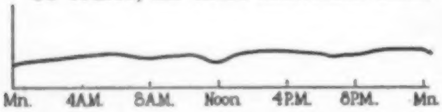


Fig. 1—Load Curve for Plant Having Even Demand

The average load and the maximum demand are nearly the same, hence the load factor for this plant is high

mum demands will never occur at the same time. So the load factor, or ratio of actual hourly consumption to the hourly consumption at maximum demand is but a fraction of the maximum demand that the power house must be prepared to meet.

It is only fair that the consumer should pay something for the privilege of using the maximum demand at times while he for the most part uses only a small fraction of this, so that his total current consumption is relatively small. In order to make a profit on their business, the electric company must charge a high unit rate for low load factor business.

Suppose the load of a plant over

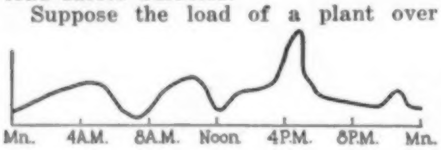


Fig. 2—Load Curve for Plant Having Uneven Demand

The average load is very much less than the maximum demand, hence the load factor for this plant is low

24 hours is as shown in Fig. 1. This load has no jumps, but runs fairly evenly, so the average load and maximum demand are nearly equal, there is a high load factor, and the cost per unit of current would be low.

In Fig. 2 is shown the 24 hour demand curve of a plant using the same amount of current, but having numerous peaks in the demand. In this second plant the average load is much smaller than the maximum demand, and the load factor is low. In such a case, it is only fair that the unit cost for current should be greater, for the same total current cost, than in the first plant.

Maximum demand can be measured by a demand meter or can be estimated. The estimated demand will usually be about 60 per cent of the connected load. If the maximum demand is metered, only the actual demand is paid for. If estimated, the rate is always the same, regardless of any savings in consumption that may be made. Most electric companies allow the privilege of a demand meter, sometimes for a nominal fee, except on very small installations. It is usually better to have the demand measured.

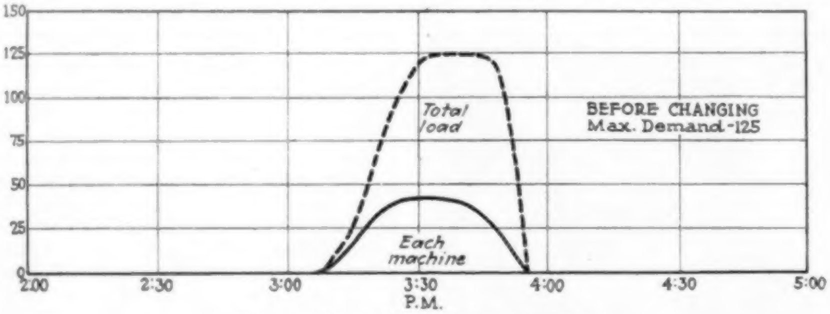


Fig. 4—Load Curve for a Process

Where the maximum demand is concentrated, all machines operating at the same time, the load factor is low

The maximum demand may be "30 minute," "5 minute," or, in exceptional cases, instantaneous." A "30 minute" demand is defined as being the point below which the load does not drop for a half hour. Fig. 3 illustrates what is meant by these different demands.

How can this knowledge of what maximum demand and load factor mean be applied, in order that money may be saved on the power bill? The possibility of reducing the maximum demand offers attractive opportunities in this direction. A case of this kind

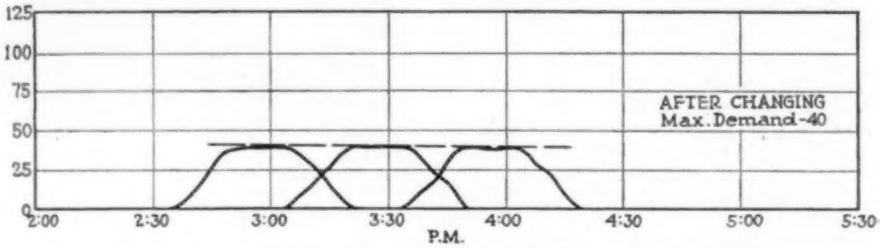


Fig. 5—Load Curve for Process Shown in Fig. 4 After Change

Here the individual demands of the machines are spaced and the load factor is increased

was recently mentioned in a technical journal. The manufacture of a certain product required several processes, one of which, while only taking ¾ of an hour, was a heavy power consumer. The 3 machines on this process were all run at the same time, giving a load curve like Fig. 4.

This resulted in a high power bill. A study of the situation showed that the process schedule could be changed so that the 3 machines would not have to be run at the same time. This was done, over-lapping the operating periods of the machines, with the resulting load curve shown in Fig. 5. The maximum demand was reduced from 125 units to 40 units. The power contract did not contain a separate demand charge, this was included in the current cost. The rates were: 6 cents per unit for the first 50 hours use of the maximum demand; 4 cents per unit for the next 50 hours use of the maximum demand; and 2 cents per unit for the balance.

This meant that with the old method of operation, 6 cents per unit was paid for the first 50 × 125, or 6,250 units. Under the new method, 6 cents per unit had to be paid on only 50 × 40 units, or 2,000 units. Thus, for the same power consumption, the new method meant fewer units at the higher rates, and more at the lower rates.

The change worked out as follows:

Before Changing		After Changing	
6,250 @ $0.06 =	$375.00	2,000 @ $0.06 =	$120.00
6,250 @ 0.04 =	250.00	2,000 @ 0.04 =	80.00
8,300 @ 0.02 =	166.00	16,800 @ 0.02 =	336.00
20,800	$791.00	20,800	$536.00
Av. per unit, $0.038		Av. per unit, $0.026	

This reduction in power costs was obtained entirely by the reduction of the maximum demand. There are many other similar cases throughout industry where such savings could be made.

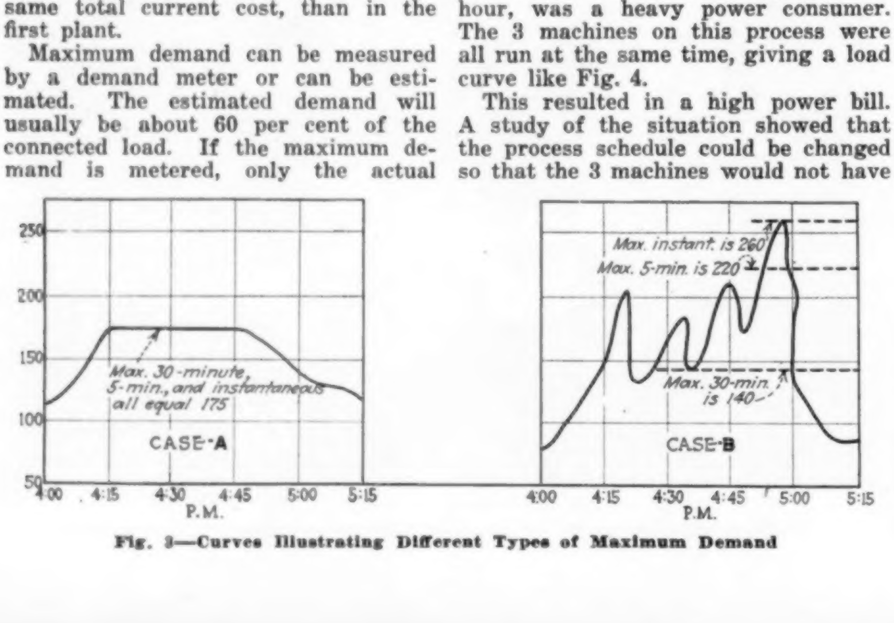
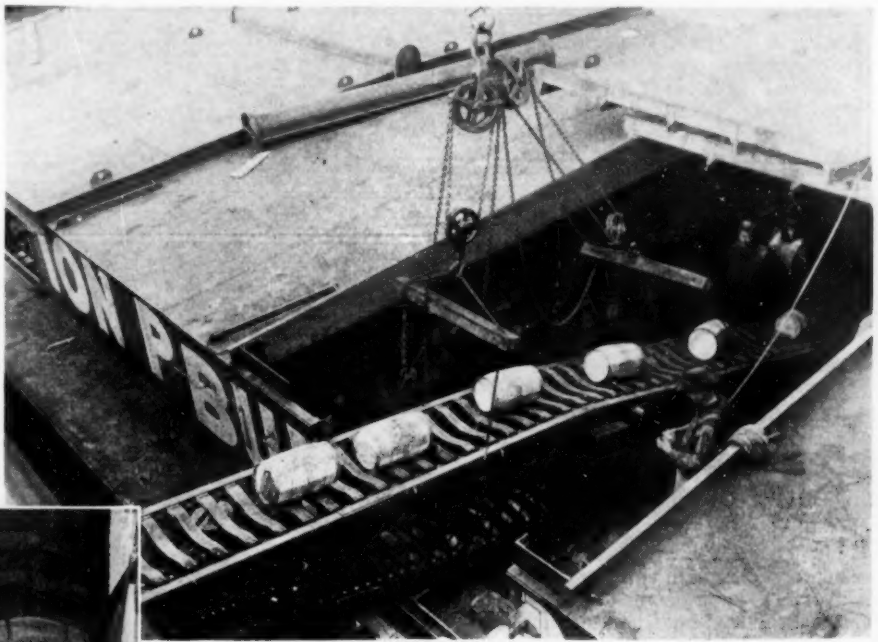


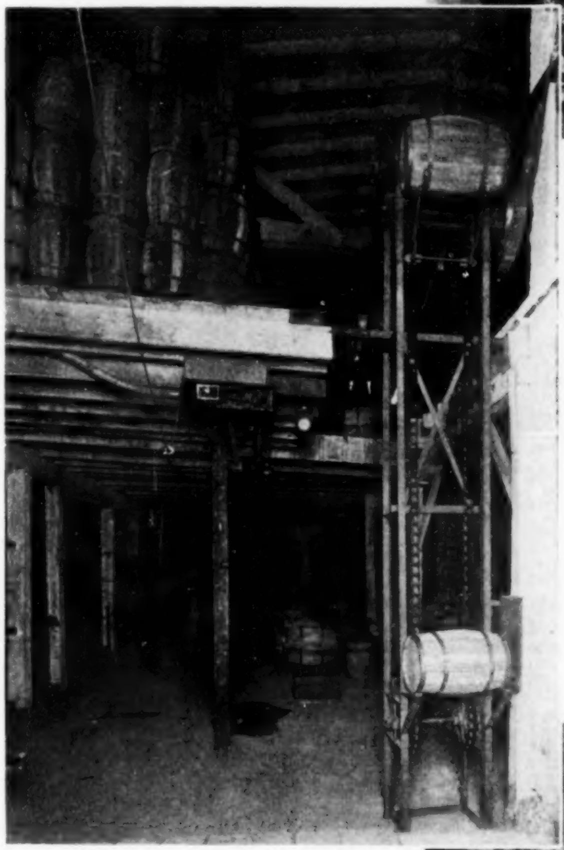
Fig. 3—Curves Illustrating Different Types of Maximum Demand

Using a Helical Screw for Agitating

The helical screw, so profitably used in conveying, finds an application in vertical oil bleaching tanks that may be new to many readers. Here it acts as a high speed, non-splash agitator. In one case an 18 inch screw driven from above, in a tank 12 ft. in diameter by 18 ft. deep, has been found to give good mixing of hot oil and kieselguhr.



Right—Many plants with a water-front location have a real problem in the loading and unloading of barges, due to the varying level relations between dock and barge. The conveyor here shown is one way of solving the problem.



Conveyors Give Good Service In Warehousing

PLACING goods into or taking them out of a warehouse is one of the most expensive operations encountered at many plants, due to the large amount of unskilled labor involved. There has recently been much activity in the development of conveyors that can be used for lightening this burden. The pictures on this page show some of the equipment devised.

Above—When the goods are unloaded and brought into the warehouse, economy of space makes it necessary to stack them as high as the building construction and dimensions will permit. A simple type of barrel elevator for this purpose is here shown.

Right—It is often convenient, in stacking goods in a warehouse, to have a conveyor such as that shown in this picture. It is portable and can be made to serve any part of the space. In addition it may be raised or lowered so that it delivers at the stacking height.

Equipment News

From Maker and User

Exhausting Acid Fumes With a Standard Fan

By E. H. Clark

Staff Engineer, American Blower Co., Detroit, Mich.

The fact that a standard ventilating fan of the "Sirocco" type will exhaust acid fumes without being harmfully corroded is not generally known. It can, however, be easily done if the fan is intelligently installed and then properly looked after. It is necessary, in order to accomplish this end, that the fan wheel be kept clean. Also, if the wheel and the inside of the fan housing are kept covered with an acid resisting paint, an added resistance to the acid fumes is provided.

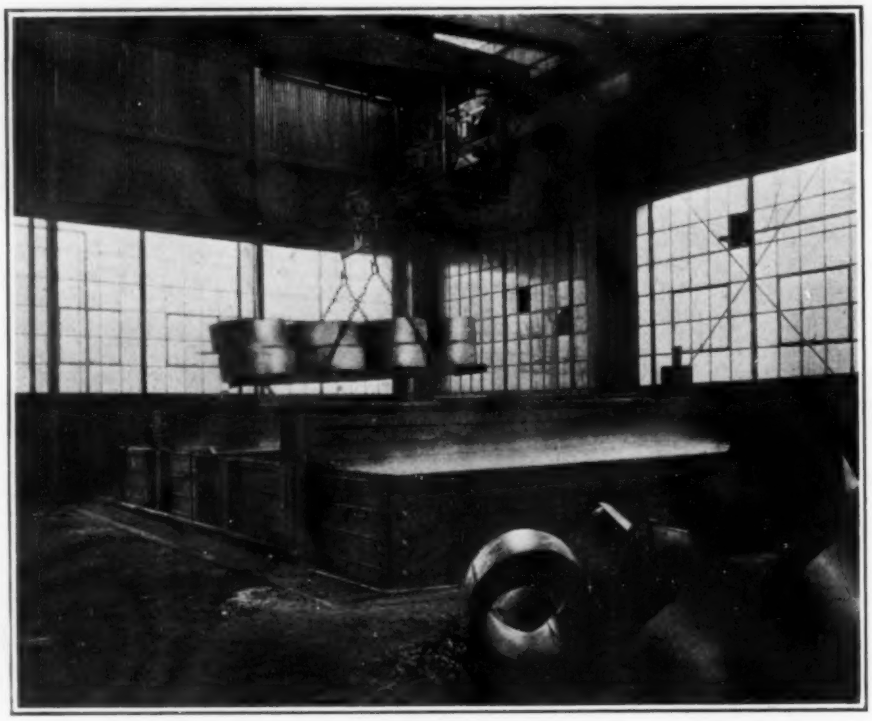
As an example of what can be done in this line, the following case is offered.

About a year ago, the Detroit Steel Corporation called us in to design an exhaust system to take away the fumes from their pickling tanks. After a survey of their problem, we decided that they required a fan to handle about 30,000 C.F.M. This was based on the use of two wooden exhaust ducts, each duct placed between two vats. At each side of the duct above the vats were narrow slots running the full length of the vats. We estimated that 1,500 ft. per minute velocity through the slots would pull the fumes to the ducts and from this, we arrived at the capacity of the fan.

A No. 8 American Sirocco, arrangement 1, was purchased to handle 30,000 C.F.M. at $\frac{3}{4}$ inch static pressure and was belt connected to a 15 H.P. motor. The inside of the fan housing and the fan wheel were given two coats of black asphaltum to resist the action of the acid. The front section of the scroll sheet was made removable so that a man could get into the fan and wash it out thoroughly with a hose at the end of each day. Furthermore, he could remove the wheel by slipping back the shaft and rolling the wheel out through the front of the fan. This was preferable to taking down the wooden duct which was connected to the fan inlet. Also a 1 inch drain was connected to the bottom of the scroll sheet to drain the water out of the fan.

The fan has been working nearly a year and is delivering the goods. It is diligently cleaned and repainted now and then and, so far, is none the worse from the action of the acid. "The Michigan Mutual Shop Man," published by Michigan Mutual Liability Co. of Detroit, recently carried an article with illustrations covering this plant and we quote below what the Editor says about the exhaust system:

"Attention is called to the arrangement and method of removing sulphuric acid fumes from these vats. One pickling and one washing vat constitute a pair, between which is a wooded suction box of about 18 inches square section. A man can work alongside of these tanks all day and get no smell of acid, and the overhead structure and crane are not affected in the least degree, because the fumes are so effective-drawn into the narrow slots in the sides of the box. A fan located in a suction chamber at the end of the tanks furnishes ample suction. The position of the intake leaves the tops of the tanks unobstructed, permitting bulky material to be lowered directly into them, and the tanks are easily drained into a sump built into the floor underneath them. We have seen many pickling departments, some of which cost many times as much money for equipment and suction systems, but where the results attained are far inferior."



View of Pickling Vats
Showing installation of ducts by means of which the acid fumes are carried away through a standard Sirocco fan.

Electric Glass Lehrs

Close temperature control within narrow limits through the annealing cycle, together with a better quality of output, are the outstanding claims for the application of electric heat to glass lehrs by the Illinois Pacific Glass Co. at San Francisco. Following this company's dissatisfaction with its old method, an experimental electric lehr with a connected load of 125 kilowatts was placed in operation in 1921 and, since that time, the size of the electric lehrs has gradually increased and two equipments recently purchased by the company for use in its Alton, Ill., plant have a connected load of 470 kw. each.

The initial installation, one of the first large installations ever made, was designed in co-operation with engineers of the General Electric Co. The electrical equipment for this and subsequent installations is of General Electric manufacture and consists of heating units with an individual automatic temperature control for each temperature zone.

The product annealed by this process is glass bottles. The glass at red heat is placed on a conveyor, is carried through a heating zone to equalize the temperature in the glass, and then passed into a lower temperature zone for gradual cooling. The value of the close control by the use of electric heat is shown by the fact that, were the glass not cooled uniformly and at a definite rate, strains would be set up in it, allowing easy breakage. The Illinois Pacific Glass Co. has found that its customers insist on the electrically annealed bottles in preference to the old type.

Operating economies of the electrical equipment have been found to compare favorably with the old equipment. Maintenance of the new lehrs is said to be negligible, the upkeep cost of the first experimental lehr being given as not over \$50 for $3\frac{1}{2}$ years.

Single Roll Crusher

The Pennsylvania Crusher Co., Philadelphia, Pa., has recently completed a new design of single roll coal crusher. With the increasing use of stokers for industrial and power plant furnaces and the extension of the use of crushed coal for gas and coke plants and for feeding the pulverizers of powdered coal installations there is an increased interest in coal crushing and much interest in equipment to furnish finer and more uniform sizing of coal with unfailing reliability. In this field the single roll crusher is popular and makers of such equipment claim that it gives a fine and uniform product, is simple in construction, dependable and has a low upkeep cost.

The new crusher referred to above is called the "Armorframe." Fig. 1 shows a cross-section of this crusher, indicating the method of operation. It also shows the spring relief that serves as a protection against any iron or other uncrushable material that may get into the feed. The natural agitation caused by the teeth of the roll passing through the coal at the top of the roll causes the finer pieces of coal to feed rapidly through the crushing zone with minimum of crushing. This partly accounts for the low percentage of fines produced by this crusher. The size and adjustment of the spring suspension to prevent the yielding of the springs for any except uncrushable materials accounts for the minimum of oversize material.

Reference to Figs. 2 and 3 will show the construction features of this new line of crushers. Bethlehem section 30-inch I-beam girders form the side frame construction of these crushers. Cross members of heavy channel and angle plate are hot riveted to the girder beam side frames to form the rigid unbreakable unit construction. Electric steel bearing housings, accurately shouldered into the side frames to take the shear, and hot riveted in position, are fitted with interchangeable die cast bearing bushings, and thorough lubrication is provided by steamboat type grease cups. A segmental roll of special patented construction with no bolts through the crushing surface to weaken the segments, affords greatest strength and provides ready accessibility for changing when necessary.

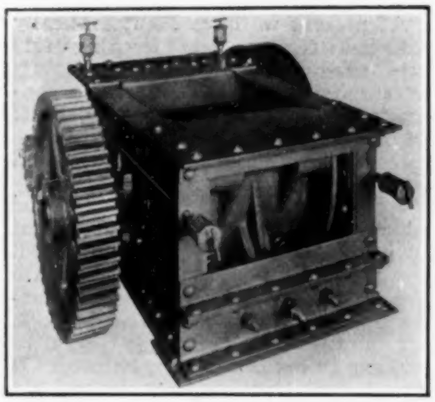


Fig. 2—View of Single Roll Crusher
Showing relief springs, adjusting screws for breaker plate, and grease cups for lubrication

The frame carries, in addition to the main roll shaft and the countershaft, a pivoted breaker plate which is adjustable to and from the crushing roll to vary the size of product. A 1-inch product with little oversize can be supplied for stoker feed or for pulverizers; 6-in. crushing for preparation of coal for hand fired locomotives is equally possible. Any size between these two limits is easily obtained by means of the breaker plate adjustment.

Supporting the breaker plate are heavy compression springs, designed to yield for the passage of tramp iron or other uncrushable materials, but which will not permit the passing of oversize coal through the choke feeding of the crusher. The crusher, operates equally well without feeder and regardless of the amount of coal in hopper or bin over the roll.

Besides the spring suspension of the breaker plate, a special safety device employing an ordinary steel bolt in hardened steel bushings prevents breakdowns in case of large iron in the feed. In normal operation this bolt transmits power from the flywheel, to the yoke which is keyed to the shaft. This safety device is positive in operation. Both the pinion on the countershaft and the heavy main gear on the crushing roll shaft have cut teeth to insure smooth operation.

Triple protection against tramp iron is thus afforded in this crusher, first with the unbreakable steel frame, second with the relief springs, and third with the positive shear pin safety device. The wearing parts are all in plain sight and can be readily inspected. This accessibility helps to avoid accidents and shutdowns which may result from concealed or inaccessible wearing parts.

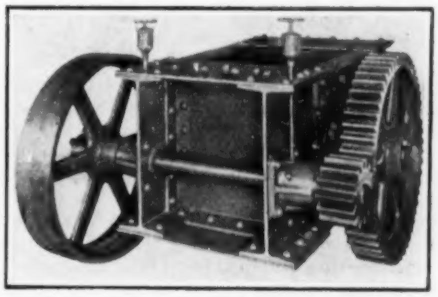


Fig. 3—Drive End of Single Roll Crusher
Note the cut gears for drive and the heavy riveted structural steel construction

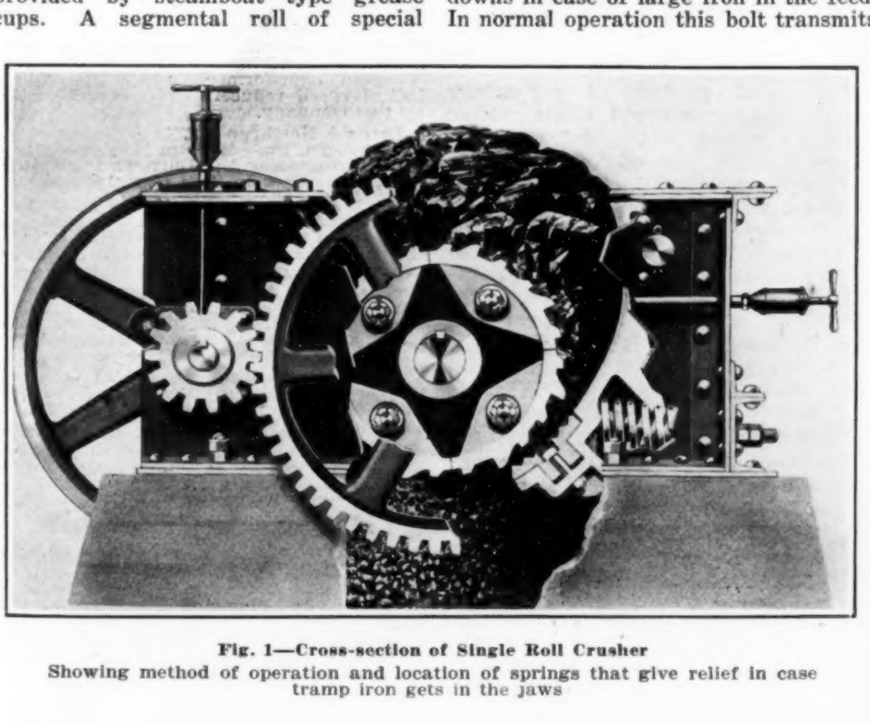


Fig. 1—Cross-section of Single Roll Crusher
Showing method of operation and location of springs that give relief in case tramp iron gets in the jaws

Heat Savings by Insulation

Of the several important advantages to be gained by the insulation of industrial heated equipment, the most readily apparent is the direct money saving resulting from the reduction in fuel consumption. In processes where fuel expense is a considerable item in production cost this saving becomes a factor that the manufacturer cannot well afford to overlook. The case of a large New York State manufacturer of gears provides an excellent example of how large a saving in fuel may be effected by the use of insulation in furnace construction.

The material used was Nonpareil insulating brick made by the Armstrong Cork & Insulation Co., Pittsburgh, Pa. These are manufactured brick composed chiefly of diatomaceous earth, a light cellular substance which is one of the best nonconductors of heat known. In the process of manufacture, the diatomaceous earth is mixed with finely ground cork, molded into brick form and fired. The cork particles are burned out leaving small "dead air" spaces which add largely to the high heat insulating efficiency of the finished brick.

Just what was accomplished through the use of insulating brick is best told by the superintendent of the heat treating department of this plant in a report covering some fuel consumption tests:

"About 5 years ago we decided to rebuild three heat treating furnaces with insulating brick in an attempt to cut down the amount of fuel required and to reduce the cost of the heat treating work. The results obtained have been even better than we had looked for and the savings effected are very important.

"These furnaces are used for carbonizing steel parts. They are oil fired and have a working floor space 4 x 6

feet. They are now constructed with a 9 inch lining of insulating brick on all sides. The 2 walls, the back and the bottom have a 4½ inch lining of fire-brick and 9 inches of insulating brick, making a total thickness of 13½ inches. The top of each furnace has a fire-brick lining 9 inches thick and 9 inches of insulating brick, making a total thickness of 18 inches. The door is 9 inches thick, with a 4½ inch fire-brick lining and 4½ inches of insulating brick. The doors are tight fitting.

"Outside engineers ran a series of tests on these furnaces both before and after the change to insulating brick was made, in order to determine the fuel requirements. The figures obtained during these tests are typical of our normal operation.

"The temperatures carried during the carbonizing are between 1,700 and 1,750 deg. F. The total gross weight of the charges used is about 4,000 pounds. The total time required for each heat is about 11¾ hours and we run 2 heats per day, 6 days a week under normal operation. After the installation of insulating brick, the fuel consumption during the tests averaged about 60 gallons per heat per furnace, and 360 gallons per day for all 3 furnaces.

"Before the change to insulating brick, the size, wall thicknesses, and construction of the furnaces were exactly the same, except that fire-brick was used throughout and the door was lined with only 4½ inches of fire-brick and it was not tight fitting. The 2 walls, back, and bottom were built of fire-brick 13½ inches thick, and the top was 18 inches thick. The operation of the furnaces was identical before and after the change, including the temperature used, the gross weight of the charges, and the time of the heats.

"Prior to the installation of insulating brick, the fuel consumed per furnace per heat averaged about 100 gallons. The 3 furnaces required about 600 gallons per day under these conditions. As the fuel consumed after the furnaces were reconstructed averaged only 60 gallons per heat, the saving effected by making this change was 40 gallons per heat per furnace, or a total of 240 gallons per day for the 3 furnaces. This is a saving of 40 per cent of the fuel required previously.

"It should be noted that this is a 40 per cent reduction in the total fuel required, and not merely a 40 per cent reduction in the amount of heat lost by radiation and conduction.

"Only a comparatively small part of this saving was obtained by making the furnace tight fitting. Most of this saving was due to the use of the 9 inch lining of insulating brick. In a year of normal operation, this saving amounts to 72,960 gallons of fuel oil. The value of this saving, at present prices, is about $4,377.60 per year, which equals the entire cost of making the change every 4 months.

"This saving was even greater at the time due to the higher prices for fuel oil and amounted to about $8,755.20 per year, which repaid the entire cost of making the change in less than 2 months. These important savings show the practical value of insulation.

"At present we have 3 automatically controlled electric heat treating furnaces used for annealing, hardening, and carbonizing. These are also constructed of Nonpareil insulating brick and are therefore operating with the same insulation efficiency as the oil fired furnaces.

"One of the big advantages of the insulating brick lies in the fact that it can be obtained in any shape desired. This permits lining the entire furnace without difficulty, regardless of construction or appliances. The brick is very sturdy and shows no signs of cracking or deterioration whatever. It is very light and is easily and quickly set in place."

Summary

Construction of Furnaces

		Thickness Without Insulation Inches	Thickness With Insulation Inches
Walls, end & Bottom	Fire-brick	13½	4½
	Nonpareil brick	...	9
	Total	13½	13½
Top	Fire-brick	18	9
	Nonpareil brick	...	9
	Total	18	18
Door	Fire-brick	4½	4½
	Nonpareil brick	...	4½
	Total	4½	9
Working floor space			4x6 feet
Cost of making change per furnace (approx.)			$475.00

Operation of Furnaces

(Data From Tests Made By Outside Engineers)

	Without Insulation	With Insulation
Fuel used	Oil	Oil
Temperatures	1,700 to 1,750 deg. F.	1,700 to 1,750 deg. F.
Charge—gross weight of material	4,000 lbs.	4,000 lbs.
Total time per heat	11¾ hrs.	11¾ hrs.
Heats per day	2	2
Fuel consumed per heat per furnace average	100 gals.	60 gals.
Total fuel consumption 3 furnaces per day avg.	600 gals.	360 gals.

Saving Effected By Use of Insulating Brick

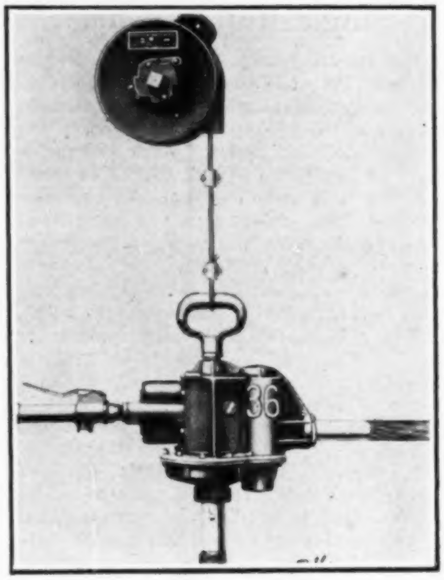
Fuel saved per heat per furnace, avg.	40 gals.
Fuel saved per day—3 furnaces	240 gals.
Saving per year—240 gals.x304 days	72,960 gals.
Value of saving at present prices—72,960 gal.x$0.06	$4,377.60
Value of saving at prices existing at time change was made—72,960 gal.x$0.12	$8,755.20

Supporting Pneumatic Tools

The usual method of supporting portable pneumatic and electric tools while these are in use, is to install an overhead sheave on which a cable or rope is placed, with weights fastened to one end to act as a counterbalance for the tool which is attached to the other end. This method is prohibited by law unless a guard is placed around the counter-weight. As a result, the equipment is rather cumbersome and hard to move from place to place.

To overcome this difficulty, the Chicago Pneumatic Tool Co., 6 East 44 St., New York City, has brought out a device called the Pedwyn Balancer. This balancer is made in two sizes, No. 1 having a capacity from 10 to 50 lb., while No. 2 has a capacity from 50 to 100 lb. Both sizes are adjustable for any intermediate load within the range of their respective capacities.

The accompanying illustration shows how the balancer is constructed. The cable that holds the tool is reeled in the drum and the tool is prevented from falling to the floor by the ratchet.



Pedwyn Tool Balancer
This device is designed for supporting portable pneumatic or electric tools while in use

The balancer can be installed in a short time in any location and can be moved to a new location and reinstalled with ease.

Manufacturers' Latest Publications

Hills-McCanna Co., 2025 Elston Ave., Chicago, Ill.—a folder describing the "40" series of bronze alloys for use in parts exposed to excessive wear.

Driver-Harris Co., Harrison, N. J.—New data sheets covering the properties and applications of "Cimet," a corrosion- and heat-resistant alloy.

The Mechanical Manufacturing Co., Chicago, Ill.—Catalog G. C. 8. A complete general catalog of machinery and equipment for the packing plant.

Stuart & Peterson Co., Burlington, N. J.—Catalog 232. A catalog of enameled equipment, mixing equipment and other chemical plant apparatus.

Cleveland Crane & Engineering Co., Wickliffe, Ohio—An illustrated folder, showing applications of the "Cleveland" hand or electric tramrail for handling inside plants.

Poole Engineering & Machine Co., Baltimore, Md.—Bulletins No. 105 and 106—Bulletins describing the Type H and Type K speed transformers, which are double helical speed reducers or increasers made by this company.

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Bulletin No. 533—A new catalog describing the Burrows Permeameter and the Epstein Core Loss Apparatus.

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. — Bulletin No. 984 — A catalog of the Vreeland Oscillator and other devices for producing high frequency alternating current.

Norton Co., Worcester, Mass.—A booklet entitled "The Balancing of Grinding Wheels," describing the advantages of and methods of balancing grinding wheels.

Taber Pump Co., Buffalo, N. Y.—Bulletin No. 120-A—A catalog describing the various types of sump pumps and vertical centrifugal pumps made by this concern.

Crescent Refractories Co., Curwensville, Pa.—Series I, No. 9—A data sheet giving heat values and air requirements of various fuels.

The Falk Corp., Milwaukee, Wis.—Bulletin No. 35—A new illustrated catalog of the "Falk-Bibby" flexible coupling.

Pennsylvania Crusher Co., Stephen Girard Bldg., Philadelphia, Pa.—Bulletin No. 50—A folder describing the new "Armorframe" single roll crusher for coal preparation.

Monitor Controller Co., Baltimore, Md.—A folder describing the Miehle Vertical Press control as designed for this press by the Monitor Co.

News of the Industry

Muscle Shoals Problem May Be Left to A Commission

Available Funds Make Such Action Probable—Prominent Men Suggested as Members

The President is expected to name promptly a commission to make recommendations as to future operations at Muscle Shoals. Since there is a balance of $150,000 remaining of the appropriation in the National Defense Act, this amount will be available for the prosecution of the study. Recommendations for the technical member of the commission are being considered by Commerce Secretary Hoover. In that connection there has been discussion, among others, of the names of H. C. Parmelee, the editor of *Chemical & Metallurgical Engineering;* Alfred H. White, Professor of Chemical Engineering at the University of Michigan, and Harry A. Curtis, Professor of Chemical Engineering at Yale University. An effort also is being made to secure the appointment of an electrical engineer to the commission. It is possible that the President may enlarge the commission to five members, but even should only three members be appointed, it is pointed out, an electrical engineer could be found who would qualify as "a representative citizen familiar with the Muscle Shoals enterprise."

The administration is understood to be particularly desirous of securing a commission of outstanding men who have not been active participants in any of the controversies which have raged around Muscle Shoals. This has eliminated some of the men who have a very comprehensive knowledge of the situation.

Former governor Lowden of Illinois was suggested prominently as the member of the commission who is to be "a representative of agriculture, versed in the use of commercial fertilizer." It is understood, however, that he has declined positively to accept such an appointment. The name of B. F. Yoakum also was brought forward but it hardly is expected that he would be chosen in view of his attitude toward the administration's plans for agricultural relief.

British Will Restrict Use of Chemicals as Preservatives

The British Ministry of Health recently issued a draft of regulations to cover the recommendations of a Department Committee regarding the use of preservatives and colors in food products. The use of both sulphur dioxide and benzoic acid or benzoates in any product is prohibited. Limits have been set for the amounts of either sulphur dioxide or benzoic acid which may be used in specified foods. Other foods may not be packed with these preservatives and the use of any other preservatives is inferentially prohibited by the regulation.

The use of compounds of poisonous metals and of certain coal-tar colors is prohibited. Of particular interest is the failure to include borax or boric acid as a preservative, which have long been used in the United Kingdom, although prohibited in the United States. The comparatively low limit for sulphur dioxide may cause some difficulty. On the other hand, American canned vegetables, which are not colored with copper, can compete on a better basis if the continental peas and beans, colored with copper compounds, are refused entry into the United Kingdom.

Some opposition to these proposed restrictions has developed on the part of British importers and manufacturers, and it is possible that the regulations may be somewhat less severe when finally imposed.

Chemical Interests Will Discuss Accident Prevention

Arrangements are being perfected for a convention at Wilmington, Del., during the middle of May, to be devoted to the discussion of accident prevention in the chemical industry. As now tentatively decided, the meeting will be for a two-day period. A committee on arrangements has been appointed, under the direction of S. H. Kershaw of the Hercules Powder Co., and engineering representatives of the Chemical Section of the National Safety Council, and a program will be outlined at an early date. The convention will be carried out jointly by the Delaware Chapter of the American Chemical Society, Delaware Safety Council, local Chamber of Commerce, Delaware Medical Association, and the Industrial Accident Board. It is stated that A. L. Watson of the Hooker Electro-Chemical Co., Niagara Falls, N. Y., president of the Chemical Section of the National Safety Council, will preside, while 200 delegates from this body are expected to be in attendance. Dr. C. M. Stine, chemical director, du Pont Powder Co., has been active in connection with the projected gathering, which is said to be the first of its kind that has ever been held solely in the interests of the chemical industry.

Development in Evaporating Waste Sulphite Liquor

Extensive tests with a small evaporator at Floriston Mills, California, by the Crown Willamette Paper Company have resulted in runs up to 450 hours without the necessity of stopping in order to clean heating surfaces. The material evaporated is waste sulphite liquor, which previously caused objectionable pollution in the Truckee River. The liquors are evaporated to 65 per cent solids for direct injection under the boilers as fuel. The pulp company has placed an order for a large evaporator of quadruple effect, 100,000 gal. per hr. capacity that will take liquor with 4 per cent solids and concentrate it to at least 60 per cent. It is not necessary to neutralize the liquor before evaporation.

The evaporator used is of a special type, invented by D. D. Peebles and previously used with success for the evaporation of such food products as milk, tomato pulp, and orange juice. It will be described in detail in a subsequent issue of *Chem. & Met.*

Funds Available for Research Work of Bureau of Chemistry

During the fiscal year beginning July 1, the Bureau of Chemistry will have available $123,400 for conducting investigations relating to the application of chemistry to agriculture. An additional $788,860 has been appropriated to carry into effect the Pure Food and Drug Act. For investigating and demonstrating improved methods or processes of preparing naval stores, $35,000 is made available. Among the other items are: dust explosions, $26,555; insecticides and fungicides, $27,580; tea inspection, $40,690.

The principal items making up the appropriation for the Bureau of Soils are: Soil surveys, $193,710; examination of soils, $15,510; investigations of fertilizers, $63,595; investigations of soil composition, $26,640. The amount to be available for the eradication of the boll weevil and certain other pests is $255,440.

Belgians To Make Aluminum at Vancouver Island

Belgian capitalists are exploring a deposit of a double hydrate of iron and alumina on the west coast of Vancouver Island with a view to utilizing it in the manufacture of aluminum. The mineral is believed to contain a sufficiently high aluminum content for this purpose.

Export Trade in Chemicals Gained in January

Value of Outward Shipments 12 Per Cent Higher Than in January 1924 —Imports Lower Than a Year Ago

The exports of chemicals and allied products from the United States during January continued the favorable progress that had been in evidence during the past few months and attained an aggregate value of $12,620,000, a 12 per cent advance from January, 1924, and an increase over any other month throughout 1924 with the exception of October, according to C. C. Concannon, Chief of the Chemical Division of the Department of Commerce. The imports likewise received an added impetus and although 13 per cent less than the preceding January were considerably in excess of totals for previous months, and reached a total of $18,094,000.

One of the most significant changes in the export trade was that of sulphur as more than double the amounts were shipped to foreign countries during January than in January, 1924, or a total of 64,500 tons, valued at $1,127,000.

Larger amounts of naval stores, gums and resins, medicinal and pharmaceutical preparations, pigments, paints and varnishes, explosives, and perfumery and toilet preparations were exported in the current January than in the preceding January. During January, 1925, the value of the exports of these groups were as follows: Naval stores, gums, and resins, $2,006,000; medicinal and pharmaceutical preparations, $1,608,000; pigments, paints, and varnishes, $1,482,000; explosives, $437,000; and perfumery and toilet preparations, $598,000.

Exports of industrial chemicals continued to record a slight decline, the total for January having equalled $2,090,000. In the fertilizer group, total exports of which amounted to 65,990 tons, valued at $1,199,000 in January, 1925, a slight drop from the preceding January, ammonium sulphate reflected the greatest change with foreign shipments 40 per cent under January, 1924.

Due to the appreciable losses in the exports of coal-tar crudes and intermediates, the value of the entire group of coal-tar chemicals fell from $1,283,000 in January, 1924, to $917,000 in January, 1925. Foreign sales of colors, dyes and stains amounting to 2,007,000 lb., valued at $658,000, were particularly heavy and surpassed those of any other month throughout 1924 with one exception.

In the explosives group the outstanding factor was the largeness of the shipments of smokeless powder when 479,400 lb., valued at $279,000 was exported in January, 1925. In contrast to the size of the shipments of smokeless powder was the smallness of the shipments of dynamite as but 848,000 lb., valued at $123,000 were exported.

The most striking changes in the import trade in chemicals and allied products during the current January as compared with the previous January occurred in the fertilizer group which showed a marked dimunition—24 per cent in quantity and 35 per cent in value, in perfumery and toilet preparations, which recorded an improvement of 118 per cent in value, and in essential oils, which rose 105 per cent in value. The imports of the last two groups the monetary value of which is small in comparison with the fertilizer figures although apparently having shown startling changes, were not actually unusually large. The high rate of gain may be explained by the smallness of the receipts during the preceding January.

The total imports of the main groups during January, 1925, were: Fertilizers, 202,400 tons, valued at $6,666,000; perfumery and toilet preparations, $851,000; essential oils, $613,000; paints and varnishes, $268.000; gums, resins and balsams, $2,575,000; industrial chemicals, $1,739,000; and coal-tar products, $1,912,000.

Detailed figures covering certain commodities, with comparisons for January, 1924, are as follows:

	January, 1924	January, 1925
Exports		
Benzol, lb	8,253,107	2,321,332
Sulphuric acid, lb	569,897	1,017,060
Acetate of lime, lb	326,470	1,994,836
Bleaching Powder, lb	2,047,458	2,560,748
Potash chlorate, lb	11,655	....
Potash Bichromate, lb	68,949	27,559
Soda cyanide, lb	1,906,086	29,112
Soda ash, lb	1,582,554	1,523,808
Soda caustic, lb	9,847,118	7,182,850
Sulphate ammonia, ton	13,497	8,250
Imports		
White arsenic, lb	1,925,486	2,165,633
Citric acid, lb	22,400	40,420
Formic acid, lb	95,060	111,490
Oxalic acid, lb	195,626	858,914
Tartaric acid, lb	451,360	368,032
Copper sulphate, lb	....	217,249
Potassium carbonate, lb	368,979	1,207,210
Potassium hydroxide, lb	1,047,210	1,064,177
Potassium chlorate, lb	171,426	716,237
Sodium cyanide, lb	3,219,417	2,328,625
Sodium ferrocyanide, lb	168,354	198,937
Sodium nitrite, lb	318,519	147,745
Sodium nitrate, ton	160,782	80,858
Creosote oil, gal	9,403,159	7,670,519
Naphthalene, lb	625,000	49,399

Program for Annual Meeting of A. I. C. at Baltimore

The annual meeting of the American Institute of Chemists which will be held at the Emerson Hotel, Baltimore, Md., on the evening of April 6, will open with a business meeting at 7:45 p.m. This will be preceded by a dinner. Dr. Charles Munroe of Washington will deliver an address on "Organization of Chemists in the U. S." Dr. Munroe is a charter member and ex-president of the American Chemical Society and an Honorary Fellow of the American Institute of Chemists. Dr. James Kendall, professor of chemistry at Columbia University will speak on "Some Notable Chemical Discoveries."

French Consumers Ask Special Price on African Phosphate

That a price differential on African phosphate be made to consumers in France has been proposed in a formal report to the French Senate. Another French idea is that such competition as exists between producers in Morocco, Tunisia and Algeria should be eliminated, so that they could work together to meet better the competition from American phosphate.

Application Filed for Higher Duty on Methanol

Producers and refiners of methanol have appealed to the Tariff Commission under the terms of the flexible tariff for greater duty owing to heavy imports of synthetic methanol from Germany.

The Commission has not acted on the applications, and probably will not do so for some time, as the case presents peculiar difficulties. In the first place, methanol is only one of several products obtained by the distillation of hardwood, others being calcium acetate, charcoal and tar, although methanol is the most valuable. Any cost of production fixed for methanol would be by an arbitrary allocation of costs, thus raising in a new form the perplexing questions which have confronted the Commission in the casein case. Secondly, as the German process of producing synthetic methanol is patented and secret it is believed it would be difficult to induce the producers to disclose their costs.

Imports of synthetic methanol have been increasing rapidly in recent months, the product being landed here at a price considerably below even the price of crude methanol produced in this country. In addition, the export market for this chemical, which formerly was of much importance to the domestic industry, is vanishing before the synthetic product. As a matter of fact, before the war, Germany itself purchased about two-thirds of the total exports of methanol from the United States.

The duty on methanol, under paragraph 4 of the 1922 tariff act, is 12c. per gallon.

New Company Will Produce Processed Paper

The Glassine Co., West Conshohocken, Pa., recently organized under Delaware laws, has taken over the plant of the Diamond State Fiber Co., and will improve and arrange the building for the manufacture of processed paper, known as glassine. The company proposes to begin operations at an early date, and will devote production solely to this line. Chester W. Beecher, an official of the Diamond State company, will be president and general manager of the new organization. Lawrence W. Glass has been elected vice-president and assistant manager; and George T. Fritz, secretary and treasurer.

New York Interests Investigate Sodium Deposits in Canada

It is understood that representatives of the Industrial Waste Products Corporation of New York have been investigating several large sodium deposits in the province of Saskatchewan, Canada, with a view to development by the installation of the new "spray-drying" process for chemicals, which is controlled by this firm. A plant covering this process was installed at the salt works near Dunkirk last fall, which resulted in increasing production from 30 to 50 tons of salt daily.

News from Washington

By Paul Wooton

Washington Correspondent of *Chem. & Met.*

THE chemical industry feels that it was treated very considerately by the late sixty-eighth Congress It refused to pass the Cramton Prohibition Bureau bill. It refused either to launch the government in the fertilizer business or to subsidize fertilizer manufacture at Muscle Shoals. It committed the Federal Government to a comprehensive helium program. It was fairly generous in its appropriations for the chemical activities in the executive departments. It gave new evidence of its faith in chemical warfare by raising Amos A. Fries to the rank of Major General, thereby placing him and the service he directs on a plane with the Corps of Engineers, the Ordnance Bureau, the Quartermaster Corps and other major sub-divisions of the War Department.

Commission for Muscle Shoals

While the chemical industry, as such, has had no occasion to go formally on record in the matter of the disposition of the government's Muscle Shoals properties, representatives of important component parts of the industry have been active throughout the consideration of the legislation and have influenced in no small degree the thought of Congress on this subject.

Congress adjourned without having taken definite action on Muscle Shoals. A resolution adopted by the House of Representatives, but not brought forward in the Senate, states that it is the sense of that body that the President should create a commission of three members to report on the "best, cheapest and most available means for the production of nitrate" and Muscle Shoals. It also was resolved "that it is the sense of the House that the value of the nitrate plants to agriculture depends upon the supply of cheap water power from the Wilson Dam and that as a protection to the farmers this power should not be disposed of for other purposes until Congress shall have taken action upon the recommendations of the President."

Cramton Bill Defeated

The defeat of the Cramton bill is thought to be due almost entirely to the influence of the chemical industry. Those who favor modification of the Volstead Act so as to legalize the limited use of alcohol for beverage purposes are hopelessly in the minority in Congress. Their hostility to the bill simply would have expedited its legislative progress. It was a different matter, however, when the highly respected chemical industry came forward with conclusive proof that the legislation would mean additional burdens for the wide range of industries which use industrial alcohol.

Helium Program Adopted

By passing the helium bill Congress for the first time has made systematic provision for a thorough-going program of production, exploration, experimentation and conservation. Under the terms of this legislation, which was signed by the President during the closing hours of the session, chief responsibility is vested in the Bureau of Mines. It provides for the transfer to the Bureau of Mines of $1,000,000 which had been carried in the army and navy appropriation bills for helium work. The Bureau of Mines is to take over the production of helium on July 1. While the bill prohibits exports under ordinary conditions, procedure is provided for exports of helium if in the judgment of the Secretaries of War, Navy and Interior they are essential. This covers such contingencies as might arise in the course of military operations. If commercial lines were established between the United States and foreign countries, it probably would be necessary to maintain a reserve of the gas at the foreign terminus of the line.

Nitrate Producers Compete

The Chilean producers of nitrate of soda and the European producers of synthetic nitrogen gradually are drawing tighter their battle lines. So rapidly has the synthetic industry grown that it now is challenging the control the Chilean association continues to hold over prices.

So that they may have more influence in the matter of price the European producers are taking steps looking to the creation of an international association, which probably will include the producers of certain other synthetic products.

To meet the encroachment of synthetic nitrogen the Chileans already have embarked on a program of research looking to the improvement of its processes and to the putting of its business on the most efficient basis. None would be surprised by an early move toward securing a reduction of the export tax. Such a concession has been made less likely by the political disturbances which have been rending Chile. The government is in no position at this time to forego any of its revenue. This fact together with the demoralization and increased costs which are certain to accompany such a state of affairs as now exists in the southern republic, is recognized as giving the synthetic industry a distinct advantage at a psychological time.

Significance is attached in Washington to the reported intention of the Duponts to retire from Chile and sell their nitrate lands. They have embarked in the synthetic industry at Clinchfield, W. Va. Evidently too the Guggenheims are impressed with the need for close cooperation among nitrate producers in Chile, as they have transferred their interests to a British company in which they are interested and which will bring their lands into the association.

Pine Institute Planned

That the naval stores industry is aroused thoroughly to the fact that the life of the business in this country is nearing its end is an opinion expressed by observers at the recent get-together meeting in Savannah. With this knowledge, however, is associated a very general recognition that the industry need not become extinct and full determination was manifested to take whatever steps are necessary to revivify this important activity.

A pine institute is to be established in cooperation with the factor and the consumers. The consumers seem suddenly to have come to the realization that this industry rapidly is being preempted by France and other countries. They are familiar with the difficulties of consumers who have to depend solely on foreign sources for raw materials.

There was some inclination at the Savannah meeting to criticize the consumer for being so ready to make use of substitutes. The consumer had an effective alibi, however, in the fact that he has had before him for years the spectacle of an industry running profligately through its resources without efforts tò provide for the future.

Hogs and fire are the principal two foes of the industry's future, it was brought out at the meeting. Fires destroy the young trees in the areas which would soon grow new forests. Hogs have a great fondness for a tender portion of the seedling pine. Protection against both are absolutely necessary to reforestation. Since there are vast expanses of cut-over lands which are suited for no other use there is every reason, it was pointed out at the meeting, why definite programs of reforestation should be laid out. By exercising careful conservation the existing forests can be made to supply the demand until the new trees are ready for tapping. With this plan is included also the growing of tung trees.

Organized efforts of the dairy industry to secure legislation in a number of states levying prohibitive state taxes on cottonseed oil products has aroused a storm of protest in Washington. The protest is not confined to southern Senators and representatives. Legislators from the states now considering the proposal, in some instances, are advising strongly against any such action. Administrative officials are joining in the effort to dissuade any state from taking action which would certainly provoke retaliation.

Sulphur from Public Lands

Sulphur has been added to the minerals covered by the general leasing act, a bill to that effect became a law during the closing days of Congress.

The recovery of sulphur from deep strata makes it entirely comparable to petroleum, it is pointed out. By allowing a 640 acre limit it is believed the production of sulphur on the public lands will be encouraged. Sulphur beds frequently are encountered in the drilling of oil wells. This legislation will allow the oil operator to take advantage of any discovery of sulphur.

News in Brief

Canadian Coke Ovens Renew Operations—Last month the coke ovens of Fernie, British Columbia, produced the first lot of coke turned out there for 6 years. There are now 128 ovens in operation and others are being heated as quickly as possible.

Foreign Syndicate to Control Exports of Magnesite — The magnesite producers of Austria, Czecho-Slovakia and Hungary have formed an export sales syndicate centered upon the existing export organization of the Veitscher Magnesitewerke of Austria. The syndicate began to operate in February and will handle 85 per cent of all export business from those countries.

Oil and Gas Power Week—To arouse national interest in oil and gas conservation, chemists and engineers in co-operation with Federal departments and other groups will hold meetings throughout the country April 20 to 25, this period having been designated as Oil and Gas Power Week.

Arthur D. Little Elected Chairman of Chemical Exposition Committee — Arthur D. Little, president of Arthur D. Little, Inc. of Boston has been elected to succeed Charles H. Herty as chairman of the Advisory Committee of the Exposition of Chemical Industries. Dr. Little is one of the most widely-known chemical engineers in this country and is one of the pioneers in the modern American chemical industry.

New Creosoting Plant for Canada—The Canadian Creosoting Co., of Toronto, has taken a lease of 1,000 feet of water-front at New Westminster, B. C., and has purchased several acres of land adjoining, on which it purposes to erect a creosoting plant. Large storage tanks will be erected on the water-front, and these will be used to supply the company's branch plants in the Prairie Provinces, as well as the plant to be built at New Westminster.

Consolidation of Chilean Nitrate Companies — Negotiations are under way for the consolidation of the Lautaro and Antofagasta nitrate companies, in order, among other things, to strengthen the position of the Chilean nitrate industry to meet competition from synthetic nitrate producers, says a report to the Department of Commerce from Santiago. The combined production of these two companies amounts to approximately 25 per cent of the total nitrate produced in Chile.

Proposed Institute of Chemo-Medical Research—In planning for the development of its Department of Chemistry, Georgetown University, Washington, D. C., proposes to establish an endowed Institute of Chemo-Medical Research. The Institute is to be directed by experts in organic, inorganic and physical chemistry, pathology, bacteriology, pharmacology and biochemistry. They will be assisted by research fellows and graduate students. The estimated endowment required is $3,680,000, of which $1,000,000 is for building, equipment and library. The income from the remainder is to be devoted to research.

Appropriation for Naval Research Laboratory—The Naval Research Laboratory is to have an appropriation of $150,000 for its work during the next fiscal year. The naval appropriation act, recently signed by the President, makes provision for the temporary employment of civilian scientific assistants.

Favors Metric Standardization—Action favorable to metric standardization of weights and measures was taken at the great Pan-American Standardization Conference, which recently met in Lima, Peru. By resolution it was urged, "That the units of weights and measures in the various countries tend toward the decimal metric system." The United States of America, represented at the conference by an official delegation, is included in the recommendation. All the other American republics are already on the metric basis.

Centrifugal Oil Settling Plant in Service—The Pure Oil Co., Columbus, Ohio, has completed the installation of a new process centrifugal cold settling plant at its oil refinery at Cabin Creek Junction, W. Va. The new plant represents an investment of close to $500,000, and is said to have developed highly satisfactory service during a brief period of operation. It will make possible the production of low cold test lubricants, and bring about considerably increased output at the refining plant.

Ethyl and Denatured Alcohol Subject to Import Duty

Under date of March 5, the Treasury Department issued notices to collectors and other officers of the customs, relative to the status of ethyl alcohol and denatured alcohol. The notice states that at present ethyl alcohol may not be imported but in the event that licenses for import might later be granted, such importations would be held dutiable under paragraph 4 of the Tariff act. Denatured alcohol also is subject to duty under that paragraph which reads:

"(a) In view of the provisions of Section 2 of the Supplemental National Prohibition Act of November 23, 1921, ethyl alcohol, as such, cannot be imported into the United States until such time as the Commissioner of Internal Revenue shall find the quantities on hand, and the quantities being produced by domestic manufacturers, insufficient to meet the needs of the country for alcohol for non-beverage purposes. Such conditions does not exist at the present time, and permits are not being issued for importation of such alcohol. In the opinion of this office, tax is due on such alcohol, if imported for non-beverage purposes, under permit, at the rate of $2.20 per proof gallon, under the provisions of Section 600(a) of the Revenue Act of 1918.

* * * * * * *

"(b) There does not appear to be any prohibition on the importation of either specially or completely denatured alcohol with or without permit. If, however, either specially or completely denatured alcohol is imported into this country, this office regards it as subject to the same tax as the undenatured alcohol, as set forth in paragraph (a)."

Discovery of Potash Deposits in Texas

Following extensive investigations and tests in the western part of the state of Texas, Dr. David Flood, Wichita Falls, Tex., mining and metallurgical engineer and investigator on occasions for the Rockefeller and Carnegie Foundations, has announced important discoveries of potash deposits on the west side of the Marathon geological field, in the district lying between Hardeman and Jones Counties. The tests show that the potash strata was struck somewhere between the 1,000 and 3,000 ft. levels, with material running as high as 30 per cent pure in different localities. The deposits lie in the horizons conforming to the oil sand horizons of the area, and the material is also apparent in the many slush pits around the oil wells. Plans will be perfected at an early date to develop a portion of the new fields.

Production of China Wood Oil Last Year Was 75,000 Tons

Consul General P. S. Heintzleman, at Hankow, states that it is estimated the 1924 harvest of nuts yielded approximately 75,000 tons of China wood oil of better than average quality. Although political disturbances in the interior retarded the movement of cargoes and created some uncertainty as to future arrivals, shipments were made regularly throughout the last quarter. Prices were generally high throughout the quarter and brought out heavy shipments of all spot cargo.

In the table below are given total exports from Hankow and shipments to the United States:

	Total Exports	Quantity
Oct.	16,600,000 lb.	14,100,000 lb.
Nov.	16,455,000 lb.	10,534,000 lb.
Dec.	11,100,000 lb.	10,000,000 lb.

The imports of China wood oil into the United States during the last quarter reflected the heavy shipments from China although the full effects of the latter were not felt owing to stocks in transit. Receipts were more than double those for the same period of 1923. However, owing to the slow movement of stocks through the first three quarters, receipts for the year were slightly less than during 1923, the amounts being 81,587,854 and 87,291,675 lb. respectively.

Brunner, Mond Controls British Sulphate of Ammonia

Brunner, Mond and Co. have become the dominating influence in the British Sulphate of Ammonia Federation Ltd. One of the first steps taken as a result of the shift of control was the establishment of an export sales department. This displaced eight large merchants through whom sales formerly were made. These merchants incidentally are in the market for supplies from other sources.

Lower Duty Recommended for Linseed Oil

Tariff Committee Not Agreed on Degree of Reduction—President Studies Report

A report on costs of producing linseed oil was submitted President Coolidge by the Tariff Commission, March 3, as the result of an application for a reduction in duty under the terms of the flexible tariff filed two years ago by the Bureau of Raw Materials. This was the last report signed by David L. Lewis as commissioner as his appointment expired March 4. The President nominated A. P. Dennis of Maryland to fill the vacancy.

The contents of the report were not made public either at the Commission or at the White House. It is understood, however, that the figures indicate a reduction in the present duty of 3.3c. per lb. on linseed oil would be justified. It further is understood, however, that the commissioners differed in their views of the extent of reduction justified by the comparative costs of production here and abroad, England being taken as the chief foreign competitor, and that the text of the report was in three sections, one being signed by three commissioners indicating a slight reduction, another being signed by two commissioners and indicating a somewhat greater reduction, and the third being signed by one commissioner indicating the greatest reduction. It was said at the White House that the President is studying the report.

The duty on linseed oil of 3.3c. per lb. is equivalent to 24.75c. per gal. The duty under the 1913 tariff act was 10c. a gal. The duty on flaxseed in the present tariff act is 40c. per bu. of 56 lb. The average yield of oil from a bushel of flaxseed is 2.5 gal. The compensatory duty on linseed oil, therefore, is $2.13\frac{3}{4}$c. per lb., of 16c. per gal. The protective duty on linseed oil, hence, is at present $1.16\frac{5}{8}$c. per lb., equivalent to 8.75c. per gal. It is in this protective duty that the reduction, if any, will be made, so that the new duty, if any change is made, will not, at the minimum, be less than $2.13\frac{3}{4}$c. per lb., equivalent to 16c. per gal., but the fact is that any new duty which may be fixed probably will be considerably higher as some protective duty naturally will be included for the domestic crushers. Farm organizations are strongly opposed to any reduction in the linseed oil duty, fearing that domestic crushers will be driven out of business, thus destroying the market for flaxseed.

Attractor for Boll Weevil Sought as Aid To Control

An effort to discover an attractor for the boll weevil, which, if found, may be used in some way toward control, is being made by the Bureau of Entomology in co-operation with the Bureau of Chemistry. The weevil attacks only the cotton plant, and probably is attracted by some odor peculiar to it. Considerable progress has been made, following the distillation of several tons of cotton plants in identifying the volatile substances present. Certain odorous constituents of the plant have already been isolated in the laboratory which give definite indications of slight attraction for the weevil, and extensive laboratory and field tests are under way with these substances in the effort to ascertain how they can be most effectively used.

Moderate Imports of Coal-Tar Dyes in February

According to data compiled by the Bureau of Foreign and Domestic Commerce, imports of coal-tar dyes in February amounted to 373,259 lb. with an invoice value of $365,268. Imports according to ports were as follows:

	Lb.	Invoice Value
New York	354,427	$346,859
Boston	15,142	13,699
Providence	3,586	4,398
Detroit	100	260
Philadelphia	4	52

LEADING DYES BY QUANTITY IMPORTED

Indanthrene blue GCD	16,006 lb.
Algol brown R	15,669 lb.
Indanthrene green G, GG	11,992 lb.
Indanthrene black BB	10,061 lb.
Indanthrene yellow G	9,844 lb.

During January there was a reduction in stocks of dyes and intermediates carried in bonded warehouse as is shown by the following:

DYES IN BONDED WAREHOUSE

	Coal-Tar Dyes and Colors Lb.	Coal-Tar Intermediates Lb.
Aug. 31, 1924	507,338	1,081,287
Sept. 30, 1924	559,661	1,111,656
Oct. 31, 1924	552,556	1,050,037
Nov. 30, 1924	533,760	1,031,460
Dec. 31, 1924	575,051	1,086,108
Jan. 31, 1925	571,371	952,202

Large Decline in Production of Sulphur in 1924

The production of sulphur in the United States in 1924 dropped to 1,220,600 long tons from 2,036,097 long tons in 1923, a decrease of 40 per cent, as shown by figures compiled in the Geological Survey. The shipments also decreased, dropping from 1,618,841 long tons in 1923 to 1,537,400 long tons in 1924, a loss, however, of only 5 per cent. The shipments in 1924 were thus the second largest on record and for the first time since 1920 were greater than the production. The estimated value of the shipments in 1924 was $25,000,000, compared with $26,000,000 in 1923, at approximately the same rate per ton.

The producers stocks in hand at the end of 1923 were approximately 3,000,000 tons. The stocks were depleted during the year by the surplus of shipments over production and at the end of the year were approximately 2,700,000 tons. Stocks are still so large as to make improbable any material increase in the rate of production. About 300,000 tons of the stocks in hand at the end of 1923 was shipped in 1924.

The production of sulphur in Sicily, which averaged about 350,000 metric tons before the war, dropped considerably during and after the war, owing largely to the increase in competition for European markets of sulphur mined in Texas and Louisiana. The exports from the United States increased from 89,221 long tons in 1913 to 487,969 long tons in 1922, and 1924 they were 484,143 long tons. The agreement between the American producers and the Sicilian Sulphur Consortium in 1923, proportioning sulphur among the markets of the world, has probably benefited the Sicilian producers, as the production in Sicily increased from 137,648 metric tons in 1922 to 206,238 metric tons in 1923, and amounted to 115,045 metric tons during the first 6 months of 1924, a rate of about 230,000 metric tons for the year.

High Prices Stimulate Search for White Lead Substitute

While the is some tendency abroad to prohibit the use of white lead in paint, there is no indication of substantial demand for such action in this country. The determined efforts being made here to develop satisfactory substitutes for lead are prompted largely by the increasing price and the prospect for an indefinite continuance of the advance.

The world's lead reserves are dwindling in the face of a constantly increasing demand. Unless new deposits are discovered within a few years it is predicted that the price of lead will cross that of copper. Titanium oxide is regarded as the most satisfactory substitute for white lead and considerable quantities of that material now is going into certain American paints.

Soap Company Buys Canadian Sodium Carbonate

A report from Canada says that Lever Brothers' Vancouver branch factory has let a contract for the delivery of 25 carloads of sodium carbonate, which is to be obtained from Soda Lake, at Seventy-mile on the Cariboo road. The material is to be delivered at the Pacific Great Eastern Railway tracks for $8 per ton. Soda Lake is fed by springs containing fairly pure sodium carbonate, and each year during the dry season the carbonate crystalizes out. Several previous attempts have been made to utilize this material, but until now there has not seemed to be a steady demand for it. The railway, too, which has been completed only a few years, has made the deposit accessible.

Revised Figures for Silicate of Soda Production

The Bureau of Census has revised its figures for production of silicate of soda in 1923. In the preliminary statement, issued last November, it was stated that 36 establishments were in operation in 1923 with a total output of 696,238 tons. It has since been discovered duplications crept into this compilation and the figures have been revised and in the completed final report of the Bureau, the following will be shown:

	1923	1921
Establishments	21	21
Production, ton	419,158	280,756
Made and Consumed, ton	87,849	59,206
For Sale, ton	331,309	221,550
Value	$5,066,719	$4,641,754

Men You Should Know About

WALTER A. ALLISON, of Philadelphia, Pa., has been appointed gas engineer for the Pennsylvania State Public Service Commission.

WILLIAM FELTON BARRETT, vice-president of the Linde Air Products Co., the Prest-O-Lite Co., Inc., the Carbide and Carbon Chemicals Corp., and the Union Carbide and Carbon Research Laboratories, Inc., received the honorary degree of Doctor of Science at the annual Charter Day exercises at the University of Pittsburgh, Feb. 27. Mr. Barrett was graduated from Yale in 1904 and in the past 20 years has made notable contributions to practice in the production of oxygen, nitrogen, acetylene and helium. During the world

William Felton Barrett

war he assisted the Government as an advisor on offensive gases and was also closely identified with the first successful plant for producing helium.

EDWARD P. BARTLETT has been granted a year's leave of absence from Pomona College, California, in order to undertake work at the Fixed Nitrogen Research Lab. at Washington, D. C.

Dr. W. G. BECKER, vice-president of the National Aniline Co., New York, has sailed for a trip abroad and will be absent about 2 months.

B. D. BROWN, superintendent at the plant of the Capstan Glass Co., Connellsville, Pa., is convalescing from a serious operation.

HENRY BURT, superintendent of the Monroe Paper Products Co., Monroe, Mich., has been elected president of the American Pulp and Paper Mill Superintendents' Association.

Dr. ALEXANDER FINDLAY, of the University of Aberdeen, now in residence at Stanford University as acting professor of chemistry, addressed members of the Southern California section of the A.C.S. at Los Angeles recently on "The Appeal of Science to the Community."

Dr. E. C. FRANKLIN, professor of chemisty at Leland Stanford University, and past president of the American Chemical Society was awarded the William H. Nichols medal for 1925 for the most original and stimulating research paper published in 1924. The medal was awarded by the New York Section of the American Chemical Society, at a meeting on March 6. Dr. Franklin as a friend and chemist, was discussed by Dr. Edwin E. Slosson, of Washington, and Dr. James F. Norris, president of the American Chemical Society. Dr. Franklin, after acknowledging the honor conferred upon him in the presentation of the medal discussed informally "The Alcohols, Aldehydes and Acids of the Ammonia System."

AMOS A. FRIES, chief of the Chemical Warfare Service, was promoted to the rank of major general Feb. 24. This well-merited recognition places the Service and its Chief on the same plane with all other important branches of the Army.

JOSEPH A. HEPP, research engineer of the Union Electric Light and Power Co., St. Louis, Mo., has been elected director of the Utility Employees Savings and Loan Association. This is a $4,000,000 corporation composed of employees of the Union Electric Light and Power Co. and its subsidiaries.

H. H. HEWETSON has been appointed manager of the refining department of the Louisiana Oil Refining Co., Shreveport, La., to succeed D. E. R. Lederer, vice-president, resigned.

A. T. HINCKLEY has recently been made vice-president and general manager of the Searchlight Battery Corp., Niagara Falls, N. Y.

H. J. HOYT, chief engineer at the Morgan & Wright plant of the United States Rubber Co., Detroit, Mich., has resigned. He has been connected with the plant in various capacities for the past 19 years.

LOUIS JOHNSON has been made chief chemist with The Barrett Co., Detroit, Mich., manufacturers of road binders and Tarvia. He has been connected with the company as assistant chemist since 1918.

SIDNEY D. KIRKPATRICK, assistant editor of *Chem. & Met.*, resigned on March 15 to become director of public relations for the Ethyl Gasoline Corporation, 25 Broadway, New York. During his four years connection with this magazine, Mr. Kirkpatrick has given attention to economic and technical developments, principally in the chemical and petroleum industries.

Prof. GILBERT N. LEWIS, dean of the College of Chemistry, University of California, will deliver the Silliman course of lectures at Yale University, New Haven, Conn., 1925-26. The course was established in 1901 by Augustus Ely Silliman, and is considered as one of the most important at the university. Dr. Lewis was formerly a professor at Harvard University and the Massachusetts Institute of Technology. During the war, he was chief of the defense division of the gas service, A.E.F.

W. P. LOWDEN who has been head chemist at the Ashburn, Mo. plant of the duPont Co. has been transferred to Gibbstown, N. J., where he will be a superviser in the Acid Dept.

Dr. K. F. MEYER, director of the Hooper Foundation and professor of bacteriology at the University of California, spoke before members of the California Section of the A.C.S. on March 6 on the subject of "Recent Advances in the Control of Botulism in Canned Foods."

Dr. E. C. Franklin

L. R. MOSS resigned his position with the experimental station, Chemical Department, E. I. duPont deNemours and Co., Wilmington, Del. to accept a position as chief chemist for the Kentucky Alcohol Corporation's plant in New Orleans.

Dr. MAX MUELLER, president of the Rhodia Chemical Co., New York, has sailed for a trip to France, and will be absent about 2 months.

A. T. NEWELL, formerly with the American Agricultural Chemical Co. at Wilmington, N. C., is now superintendent of roasting kilns and acid plant for the United Zinc Smelting Corp., Moundsville, W. Va.

Dr. W. W. ORTON, scientific director and general manager of the Tropical Plant Research Foundation, Washington, D. C., stationed at Havana, Cuba, is on a visit to the United States, and will be at New Orleans, La., and vicinity for several weeks with regard to forthcoming sugar research work.

Prof. ALEXANDER SILVERMAN, of the University of Pittsburgh, has been elected chairman of the glass division of the American Ceramic Society.

R. T. STULL, ceramic engineer in the industrial department, Central of Georgia Railway Co., Savannah, Ga., has resigned, effective April 1, to become production manager for the Georgia White Brick Co., recently formed to construct and operate a plant in that section.

Dr. ALFRED TINGLE has been appointed chief chemist of the Canadian Department of Customs laboratories, at Ottawa, in succession to F. W. Babington, who has retired.

Company Reports

Seton Porter, president of the National Distillers Products Corporation in his annual report stated that the Kentucky Alcohol Corporation's present business is on a much larger scale than heretofore, and in addition to the general increase of sales now indicated, it has contracted to furnish the entire alcohol requirements during the year 1925 of E. I. du Pont de Nemours & Co., the country's largest single consumer. During a greater part of the year the company was not adequately supplied with raw material and the Old Time Molasses Co., a Cuban corporation was purchased, which should insure an ample supply of molasses for the manufacture of alcohol.

In the annual report of the National Lead Co., Edward J. Cornish, president of the company explains that inventories have been reduced because of the high prices at which all metals were selling. He also referred to export business and said:

"The company is seriously considering a number of foreign investments. Our wages, administration and sales expenses in the United States are twice as large as in the companies in which we are interested in Europe. Our export trade is at the vanishing point. If we would continue an important factor in international commerce, we may be compelled to build or buy works in Europe and elsewhere."

Simon Guggenheim, president of the American Smelting and Refining Co. in his annual report to stockholders states: "Your company has, during the years 1923 and 1924 appropriated for mines, new undertakings and improvements $21,385,047 and has expended $15,687,076. The largest items of these expenditures are just beginning to produce returns. The Rosita coke plant in Mexico, having a capacity of 18,000 tons of coke per month, was started in operation in Dec., 1924, together with the byproduct plant producing ammonium sulphate, benzol, tar, creosote, coke breeze and gas. The new mine plant at Rosita will be completed by next June and will have a capacity permitting the mining of 50,000 tons of coal per month. The new Rosita zinc smelter, operated by the gas of the byproduct coke plant, and the new acid plant should be in operation by the first of March, 1925. Our first arsenic plant in Mexico has been installed at San Luis Potosi and began operating late in the year. The new copper smelter at that place should commence operating next July."

Canada Reduces Importation of Chemicals

During the twelve months ended January this year, Canada imported chemical products valued at $24,605,000, a decrease of $1,539,000, compared with the previous twelve month period. Imports from the United States totaled $16,242,000, a decrease of $2,434,000. Imports of sodium compounds from the United States totaled $2,059,097, a decrease of $499,707, while purchases from the United Kingdom were $401,349, an increase of $100,820.

Obituary

Arthur E. Stevens, vice-president of the Chope-Stevens Paper Co., Detroit, Mich., died recently, aged 57 years.

John Hawley Taussig, gas engineer of the United Gas Improvement Co., inventor of gas-making apparatus, and in the late '90s a famous Cornell football player, died March 3, at the Chestnut Hill Hospital, Philadelphia, Pa., where he had been ill for a short time. Mr. Taussig was 49 years old. Following his graduation from Cornell in 1897 he was in the engineering department of the Philadelphia Gas Works for three years. Then he went to Newark, N. J., as superintendent of the Market Street Gas Works, but three years later returned to Philadelphia as assistant engineer of tests with the U.G.I., where he had been since that time.

Calendar

American Chemical Society, Baltimore, Md., April 6 to 10.

American Association of Cereal Chemists, annual meeting, St. Louis, Mo., June 1 to 5.

American Electrochemical Society, Niagara Falls, April 23 to 25.

American Institute of Chemical Engineers, semi-annual meeting, Providence-Biltmore Hotel, Providence, R. I., June 22 to 25.

American Institute of Chemists, annual meeting, Emerson Hotel, Baltimore, Md., April 6.

American Oil Chemist's Society, sixteenth annual meeting, Roosevelt Hotel, New Orleans, La.., May 11 to 12.

American Pulp and Paper Mill Superintendents Association, Niagara Falls, N. Y., June 4 to 6.

American Society of Mechanical Engineers, spring meeting, Milwaukee, Wis., May 18 to 21.

American Society for Steel Treating, spring sectional meeting, Schenectady. Headquarters, Hotel Van Curler, May 28 to 30.

American Society for Steel Treating, annual convention and National Steel Exposition, Cleveland, Ohio, the week of Sept. 14.

American Society for Testing Materials, annual meeting, Atlantic City, June 22 to 26.

Brussels International and Commercial Fair (sixth), Brussels, Belgium, March 25 to April 8.

Chemical Equipment Exposition, Association of Chemical Equipment Manufacturers, State Armory, Providence, R. I., June 22 to 27.

Colloid Symposium (Third National) University of Minnesota, Minneapolis, Minn., June 17 to 19.

Interstate Cotton Seed Crushers Association, annual convention, Roosevelt Hotel, New Orleans, La., May 13 to 15.

Iron and Steel Institute (British), annual meeting, London, May 7 and 8.

National Exposition of Chemical Industries, New York, Sept. 28 to Oct. 3.

Society of Chemical Industry, N. Y. Section, March 20.

Society of Industrial Engineers, national convention, Hotel Winton, Cleveland, Ohio, May 6 to 8.

Southern Exposition, Grand Central Palace, New York, May 11 to 23.

Industrial Notes

The Joseph Dixon Crucible Company, Jersey City, N. J., manufacturers of graphite products, has removed its Boston office to the new Chamber of Commerce Building, 80 Federal Street.

The Hyatt Roller Bearing Co. of Harrison, N. J. has appointed P. C. Gunion, for six years advertising manager of the Hyatt Co., to a place on the sales board. Mr. Gunion will also head up the market research activities in addition to his advertising work.

The Combustion Engineering Corp., New York, N. Y., announce the appointment of W. R. Quinn, former manager of the fuel oil department as Pacific Coast agent with headquarters in San Francisco. Mr. Quinn's territory will include the states of Washington, Oregon and California.

The Bailey Meter Co., Cleveland, Ohio, has recently secured the service of W. A. Shoudy as consulting engineer. Mr. Shoudy still retains his connections as advisory engineer to the Adirondack Power & Light Corporation, Schenectady, and as associate in mechanical engineering at Columbia University. He will also carry on his other consulting work with headquarters at 50 Church Street, New York City.

The Mutual Chemical Co. has moved its New York office to 270 Madison Avenue. The move was prompted by the growth of the company which necessitated larger office facilities, and a desire to consult the convenience of customers by locating in an accessible portion of the city.

The Dings Magnetic Separator Co. of Milwaukee, Wis., announces the appointment of C. R. Considine as its representative in Iowa and Minnesota territory. Mr. Considine will handle this business from 1022 Langworthy St., Dubuque. Iowa.

The C. J. Tagliabue Manufacturing Co., 18 33rd Street, Brooklyn, N. Y., has created a new department, known as the Engineering Research Department, to be headed by Victor Wichum, who continues as chief engineer.

The Pennsylvania Crusher Co., Stephen Girard Bldg., Philadelphia, Pa., has recently appointed the Stratton-Cahoon Co., 809 McIntyre Building, Salt Lake City, Utah, district agents for the sale of its line of coal preparation machinery and heavy duty primary, secondary and fine crushers for limestone, gypsum, cement rock and ores.

The Diamond Power Specialty Corp., announces the appointment of Lynn W. Nones as Eastern Sales Manager, in charge of the Atlantic Coast offices from Boston to Charlotte, inclusive. His office is at 90 West Street, N. Y.

The Herreshoff Furnace Division of the General Chemical Co. has been taken over by the Nichols Copper Co. of 25 Broad St., New York, N. Y.

Market Conditions

Seasonal Buying Reported in Market for Chemical Products

Tonnage Movement Holds On Fairly Even Basis—New Buying Orders Are of Moderate Volume

DELIVERIES of chemicals from producing plants during the past month compared favorably with the tonnage levels which had been established in the preceding months of the year. Call for additional lots was spotted with some selections selling freely and others moving in moderate volume. As contract commitments are generally credited to be larger than they were a year ago, the amount of new business placed is regarded as an index of general activity and the volume of buying has not been light enough to indicate any slump in consumption of chemicals nor heavy enough to reveal anything approaching a boom period in the industry.

Acids have maintained a steady position both in respect to values and to consuming demand. Shipment prices for citric and tartaric acids have been firmer and with the season of larger consumption approaching, values are expected to hold firm with any change favoring higher levels. Mineral acids hold firm with demand closely approaching supply and no selling pressure anticipated for the first half of the year. Oxalic acid seems destined to work higher as stocks of imported are small and domestic sellers are gradually obtaining control.

With the exception of foreign potash alum which has held an irregular price course, the alum group has shown steadiness. Producers appear to have adopted sales policies which preclude any chances for lower prices as there is an absence of any price competition.

Activity in fertilizer chemicals has been retarded by a marked falling off in sales of mixed fertilizers. Advances in price for the latter have been opposed by consumers in the South and this opposition has resulted in a large decline in early season buying and has created an unfavorable outlook for chemicals which are used in the fertilizer industry.

Domestic nitrite of soda is more prominent in the market than it was a year ago. The higher duty has been in effect long enough to establish a definite trading basis and foreign producers do not appear anxious to force any downward revision in values. Bichromate of soda has recovered from the keen competition which marked the contract period and a higher market is regarded as probable. Imported sulphide of soda has been firmer and stocks of domestic are relatively low as the result of smaller production.

The latest official figures for export trade in chemicals refer to January shipments. While an increase is reported for chemicals and allied products, the showing is less favorable when applied strictly to chemicals. Exports of the latter in January were valued at $4,791,395 as compared with $4,970,468 in January, 1924. Losses were registered in exports of coal-tar chemicals with benzol prominent in the decline. Acids, with the exception of acetic, boric, and sulphuric, also reported a falling off. Shipments of alcohol were smaller but gains were made in the case of calcium products and bleaching powder. Potash chemicals made a poor showing and a decline of more than 10 per cent was registered for the soda group with caustic soda shipments running 27 per cent below those of January, 1924.

Imports of chemicals also were lower, the valuations for January being $4,122,407 and $4,506,233 for 1925 and 1924 respectively. Coal-tars again figured in the loss with dead or creosote oil and naphthalene largely responsible. Colors and dyes, however, made a gain of more than 50 per cent. Substantial increases also were reported for ammonium compounds and for chlorate of potash. Prussiate was the only one of the soda group to surpass the totals for January, 1924. A notable increase was found in the case of sulphate of ammonia and it will be interesting to see what effect imported sulphate will have on the future domestic market.

Caustic Potash

Importations of caustic potash since the first of the year have been heavy. Recent buying has not been active enough to absorb stocks and it is thought that stocks in store are large. Values have been well maintained and the weight of offerings has failed to become a market factor. Reports from markets in Sweden state that caustic potash has been lower in price due to dumping of German goods. These reports, coupled with the fact that shipments to this country have been large would indicate that German producers were well supplied and were eager to move stocks. In spite of this there is no price weakness in domestic markets and spot holdings are in strong hands. Domestic caustic has been competing rather keenly with the imported material but this has had no influence on prices asked by importers. With exports from Germany under control, both as regards prices and quantities, it is futile to judge the market from a statistical viewpoint as changes may be made arbitrarily.

Chlorate of Potash

Reports that the Tariff Commission was working on its report on this chemical have been current in the market. Rumors also have anticipated the findings of the Commission and have asserted that the import duty would be placed at 2¼c. per lb. which would represent an increase of three-quarters of a cent per lb. which is the maximum possible under the provisions of the tariff law. Whether or not influenced by these reports, consumers have shown interest in chlorate and recent buying has been of large proportions. At present demand has eased off as buyers evidently have covered for a period ahead and values are not showing the firmness which prevailed for the preceding 2 or 3 weeks. There is little, however, to encourage any belief in sustained lower prices and should reports of an increase in duty prove correct the probability of a higher market would be enhanced.

Sulphuric Acid

Reports from the fertilizer industry indicate that consumption of sulphuric acid has not come up to expectations. In other directions demand has been active and consumption has increased materially over that of a year ago. Surplus stocks have been held to a minimum and prices have shown a uniformly stable basis. Production costs have been fairly steady and there have been reports that an advance in the price for brimstone was imminent. Producers, however, have denied these reports and the fact that government lands are to be opened up for enlarging production is regarded as a guarantee against an advance in price.

Arsenic

At the beginning of this year, it was estimated that domestic producers had on hand more than 5,000 tons of arsenic. Large amounts also were held by dealers and consumers. The large visible supply has cut down domestic production and surplus stocks are still reported to be large. Despite the unfavorable market, imports of arsenic in January were 2,165,633 lb. as compared with 1,925,486 lb. in January, 1924. The invoice price for January arrivals averaged 6.87c. per lb. as against 10.48c. per lb. in January, 1924. It is significant that recent sales of arsenic have been made at 5c. per lb. and in spite of reduced outputs, the outlook for sellers is anything but bright and, sacrifice sales may force prices to lower levels.

Chem. & Met. Weighted Index of prices for Oils and Fats

Base = 100 for 1913-14

This month	161.32
Last month	113.63
March, 1924	128.02
March, 1923	150.82

Advances in price have been almost general throughout the oil list. Crude cottonseed, coconut, corn, China wood and palm oils contributed chiefly to the rise in the index number, with tallow and greases adding to the net advance.

Large Consumption of Alkalis

Producers are carrying orders for caustic soda in sufficient volume to insure a large consumption of these products. Productive capacity, however, is considerably above normal consuming requirements and business placed since the first of the year has hardly been sufficient to warrant any large increase over the output of last year which was approximately 400,000 tons. Reports indicate a larger output in the first quarter of this year than in the corresponding period last year. Reports on activity vary as some producers report steady business while others say that not only spot trading has eased off but there also has been a tendency on the part of consumers to defer contract deliveries. Contract prices appear to be firmly established and the same is true for prompt business but some irregularity in the latter is noted and evidently sellers have surplus stocks which they have been eager to liquidate.

Soda ash is moving freely into consumption and the high rate of production which was established in the closing months of last year, has been maintained. New business, while varying with industrial activities has been of seasonal character and there is nothing in the present market to indicate any change either in the way of distribution or of values.

Alcohol Prices Reduced

Seasonal slackening in demand has been felt for the anti-freeze grades and ample supplies have been a factor in bringing about a lowering in quotations. Several large consumers have covered requirements for the year and are out of the market at present. Production has been along broad lines and announcement was made last week 2 new plants were preparing to produce commercial alcohol. As supplies are large in the present market an increase in production would be a bearish factor unless consumption shows a corresponding gain.

Metal Derivatives Easier

Early in the month, producers of basic carbonate of lead announced a decline of one-quarter cent per lb. for this product. A similar revision was made in prices for lead oxides. These changes were the result of lower producing costs with especial reference to pig lead. While there has been a good call for these commodities against contracts, new business has not been active. Contract prices also have been subject to price revisions as many buyers were guaranteed against declines through June.

The easier position of the tin market had a corresponding influence on selling prices for tin salts and March deliveries of tin crystals, bichloride of tin, and tin tetrachloride were more favorable to buyers than had been the case in the preceding month.

Wood Distillation Chemicals

The introduction of synthetic methanol into domestic markets has had a depressing effect on this branch of the chemical industry. Many consumers of methanol, through price considerations, have given the preference to the synthetic. Naturally this has cut into the sale for methanol and has placed the market for the latter in a precarious position. As a result of this competition an application for higher duty has been made by domestic producers and refiners. The present duty is 12c. per gal. and the maximum increase under the flexible provisions of the Tariff act would place the duty at 18c. per gal., which would still leave the price advantage with foreign synthetic methanol. Imports of the latter are reported to be gaining in volume and are placing steadily growing limitations upon the field for domestic offerings.

Acetate of lime also is affected adversely by synthetic methanol because Germany which offered the largest export outlet is no longer in the market. Exports of acetate of lime in January were 1,994,836 lb., but a falling off in outward shipments is logical unless new markets can be developed. Acetone continues to meet with competition at home with the fermentation product offered freely and with prices none too stable.

Lower Duty for Linseed Oil

Ordinarily the seed supply and demand for oil and oil-cake are the factors which regulate values. At present, interest has centered in the prospective lowering of duty on oil. It is regarded as certain that a lower duty will become effective but the reduction has not yet been announced. Even a slight change will bring competition from foreign-made oil and will have a bearish influence on domestic markets. Seed values at Duluth and at Buenos Aires have been declining and the statistical situation in itself is regarded as pointing toward lower values for oil. Recent advices from the Argentine have stated that linseed yields were exceeding expectations and estimates on the Argentine exportable are being revised upward. Crop prospects in the American northwest also are encouraging. The high prices received for the last crop are said to have influenced farmers to a determination to plant a large acreage and another 30,000,000 bu. crop is probable. Most of the domestic seed already has been marketed and with Argentine shipments to date, domestic crushers have a supply for the crop year in excess of 30,000,000 bu. Total requirements are expected to approximate those of last year which were about 35,000,000 bu.

Imports of Vegetable Oils in January

Imports of vegetable oils were heavy in January, running far in excess of the totals for January, 1924. Official figures offer the following comparisons:

	Jan., 1925	Jan., 1924
China wood, lb..	9,079,825	6,931,462
Coconut, lb.	26,920,773	10,827,385
Sulphur, lb.	3,303,241	510,679
Palm, lb.	8,029,074	4,805,637
Palm kernel, lb..	4,180,717	119,583
Peanut, lb.	230,783	622,899
Rapeseed, gal. ..	154,139	71,154
Linseed, lb.	596,873	98,130
Soya bean, lb. ..	4,810,081	3,148

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	113.16
Last month	113.63
March, 1924	116.27
March, 1923	128.21

While alkalis, mineral acids, and basic chemicals, generally have held in a fairly steady basis, the weighted index number was depressed by open declines in alcohol, lead salts, tin salts, and by weakness in wood distillation, chemicals and salt cake.

Cottonseed Oil Advances

Values for cottonseed oil in the past month have been influenced largely by conditions outside that market. Sharp advances in the markets for lard, hogs, and grains induced speculative buying of oil. Consuming demand for lard compound, which accounts for about 70 per cent of cottonseed oil production, was relatively light throughout the period. The sharp rise in lard prices and the widening spread between values for lard and oil were pointed out as an indication that, eventually, the cheapness of compound would attract abnormal buying which would warrant higher prices for oil. On the basis of supply and demand, oil values are too high to be maintained. Trade opinions agree that the final official estimate of the last cotton crop was too low but using that estimate as a basis for seed production, the output of oil for the crop year, August, 1924, to August, 1925, would total 3,200,000 bbl. Distribution of oil from the beginning of the crop year through January, with comparisons for the preceding year, were as follows:

	1924-5 Bbl.	1923-4 Bbl.
August	216,000	203,000
September	157,000	169,000
October	328,000	232,000
November	281,000	219,000
December	238,000	145,000
January	262,000	203,000
Total	1,482,000	1,171,000

This would leave a supply of 1,718,000 bbl. for the remainder of the present crop year, whereas in the corresponding period last year but 1,065,000 bbl. were taken from the market. Apparent consumption for the first half of the present crop year showed a gain of 26.6 per cent over the preceding year and the supply for the second half of this year is 61.3 per cent larger than the amount consumed in the second half of last year.

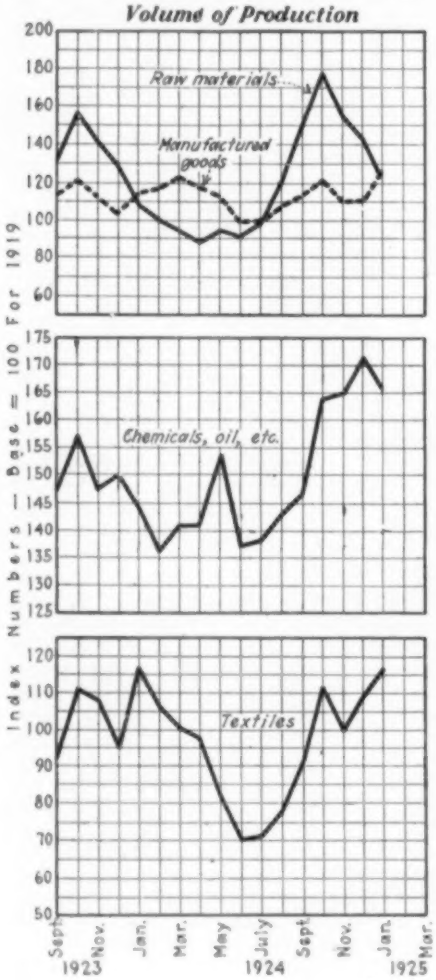
Facts and Figures of Business

In the Chemical Engineering Industries

Industrial Statistics Presented Graphically for Those Who Follow the Monthly Trends of Production and Consumption

THE TREND OF BUSINESS in the checimal engineering industries as a whole is not easily gaged for unlike the technology that ties the group together, there is no common denominator of business conditions. To be sure the fundamental economic factors that effect all business are accurately reflected in the monthly trends; in fact, certain chemicals such as sulphuric acid and the alkalies are themselves so widely distributed as to be regarded as barometers of general business. However, the inter-relations of producer and consumer are much narrower in the case of some of the products and it is to the industries themselves that we must look for the developments and tendencies that determine the present and future of their business activity.

Volume of Production



Volume of production, factory employment and wholesale price levels, are, perhaps, the most indicative of the current statistics available in the chemical engineering industries. The figures presented graphically on this page are the outstanding compilations of the federal Departments of Commerce and Labor bearing on these industries.

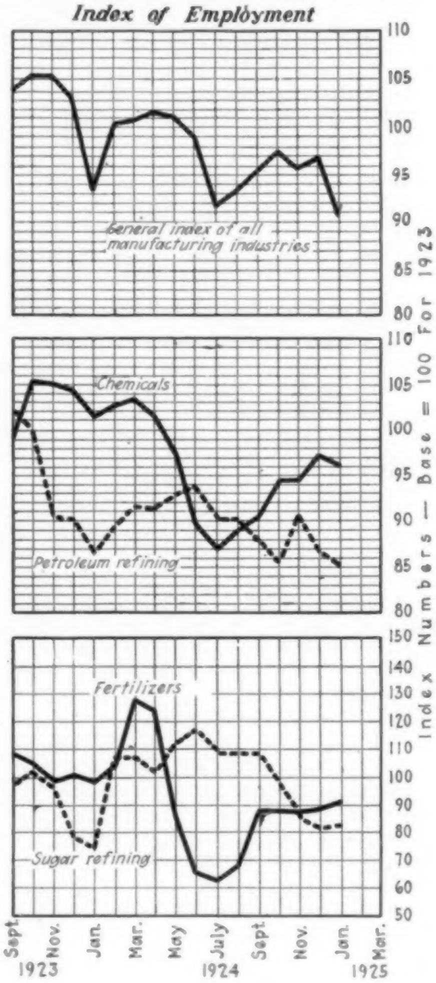
The indexes of the volume of production—dealing with raw materials and manufactured goods — are weighted combinations of series of individual numbers brought together by the Department of Commerce in its Survey of Current Business. Included in the compilation for raw materials are production statistics for 56 commodities subdivided into 4 groups as follows: (1) Minerals — petroleum, coal, iron and non-ferrous metallic ores; (2) animal products; (3) crops; and (4) forest products — lumber, pulpwood, naval stores and hardwood for distillation. Production of manufacturers is measured by an index of 64 commodities.

The chemical group, shown in one of the accompanying graphs is based on production statistics for byproduct coke, petroleum products, turpentine and rosin. In the textile group, cotton and wool consumption are the indicative figures.

The indexes of factory employment shown in these charts are based on the payroll totals of 8,785 establishments in 52 manufacturing industries covering 2,707,719 employees. There are 65 chemical plants, 70 fertilizer factories, 38 petroleum, and 13 cane-sugar refineries reporting payroll data to the Department of Labor.

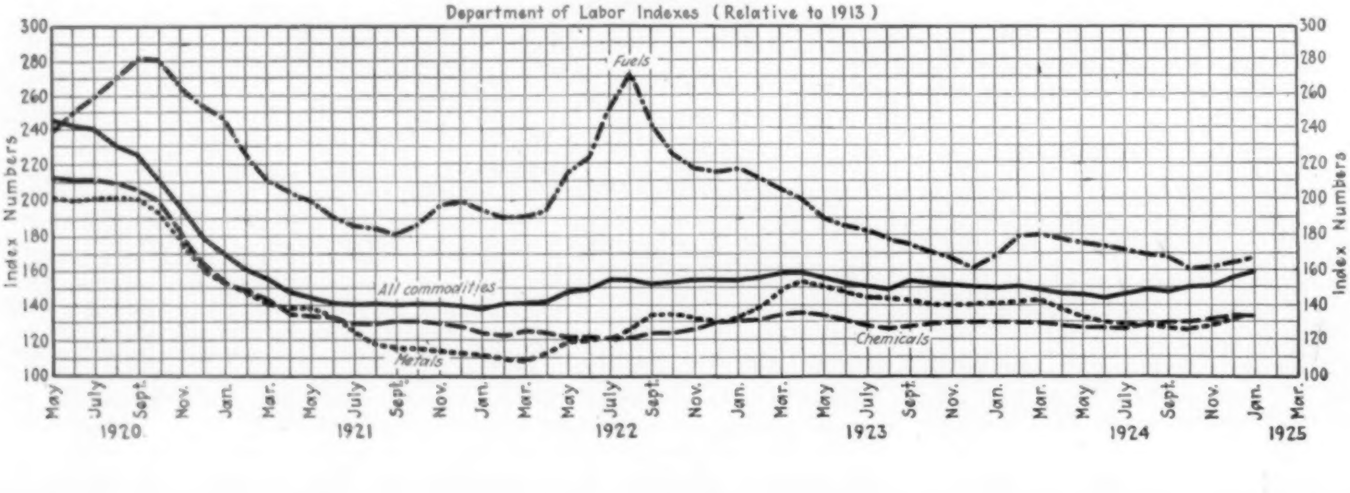
The wholesale price indexes of the U. S. Bureau of Labor statistics represent one of the oldest and best-known series of price studies. Its basis of 100 is for the fiscal year, 1913-1914. The all-commodities index is based on quotations for 404 commodities. Chemicals include 39 price series, metals 37, and fuels 19 different products.

Index of Employment



Wholesale Prices

Department of Labor Indexes (Relative to 1913)



Chemical Prices Showed Declining Tendency in Past Month

Production Reported to Be Gaining on Consumption—Consuming Industries Rely Largely on Contract Commitments

THROUGHOUT the last quarter of 1924 the industries which are large consumers of chemical placed numerous contracts for delivery over 1925. This had the two-fold result of predicating a large consumption of these commodities and of encouraging manufacturers of chemicals to operate on an active scale since they had a fairly large percentage of their output sold ahead. Throughout January large consuming trades held a favorable position as compared with that of the preceding month but were less active than in the corresponding period of 1924. The relative position of some of these industries may be inferred by a study of employment figures as compiled by the Bureau of Labor and which show the following:

INDEX OF EMPLOYMENT

	Jan., 1925	Jan., 1924	Dec., 1924
Dyeing and Finishing			
Textiles	93.0	84.1	91.8
Leather	91.5	94.7	90.4
Paper and Pulp	92.4	96.5	92.6
Chemicals	91.6	99.7	91.7
Fertilizers	91.0	97.3	88.1
Glass	88.2	92.0	89.1
Automobile Tires	102.9	90.3	102.9
Petroleum Refining	88.8	92.5	89.2

Judged by the lack of sustained buying of chemicals for prompt shipment, consuming trades have found but little need to supplement contract placements. Buyers who were not covered ahead, have not been active enough to absorb surplus production and, in some cases, stocks are reported to have accumulated at producing points. Incidentally, there have been reports that withdrawals against contracts have failed to come up to expectations. Such reports are given credence by the fact that certain heavy chemicals have sold recently at prices below those openly quoted. These sales are interpreted as a move on the part of manufacturers to work off surplus stocks or as a stimulus to increase buying in order to hold up production. In either event, it would appear as if production of chemicals had been gaining over consumption.

Decline in Index Number

The weighted index, number for chemicals reflects general conditions of activity and bears out the assumption that buyers have been favored in recent transactions. At present the weighted number stands at 113.16 as compared with 113.63 on Feb. 15 and with 116.27 on March 15, 1924. Reductions in prices for alcohol, lead salts, and tin salts have played an important part in lowering the number but the easier trend to values will become more apparent if consideration is given to price concessions which have been made in sales of wood distillation chemicals, prussiates, arsenic, alkalis, lithopone, and dry colors. In sharp contrast to chemicals, a very strong market has ruled for vegetable oils and fats. The weighted index number for oils and fats has advanced from 148.33 on Feb. 15, to 161.32. A logical reason for the advance in values for fats and greases, is found in conditions surrounding supplies and production costs. The latter conditions have had a sympathetic effect on domestic oils and undoubtedly have exerted some influence in bringing about higher primary markets for Oriental oils.

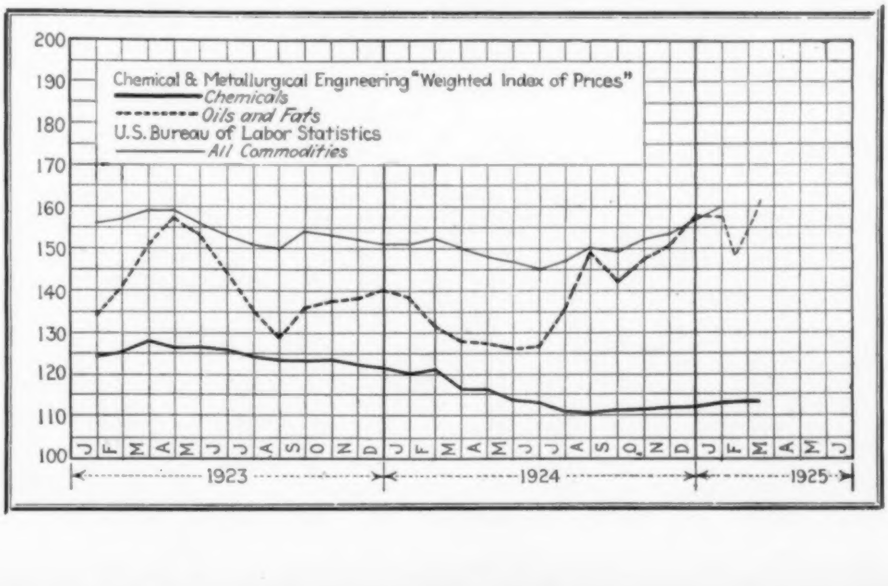
Tariff Changes Aid Production

Granting of higher import duties under the flexible provisions of the Tariff act, promises to add materially this year to domestic production of nitrite of soda and oxalic acid. In the case of the latter, the higher duty did not go into effect until nearly the end of last January. Imports during that month were heavy, amounting to 858,914 lb. and while arrivals from abroad have since been curtailed, there have been stocks of the imported material on hand to offer competition with the domestic product. Indications point to a more or less speedy lessening of such competition and the ultimate domination of domestic oxalic with a corresponding increase in its output. The increase in duty on nitrite of soda became effective last June. With higher tariff protection domestic production which had been suspended was resumed in the latter part of last year. Imports of nitrite of soda in January amounted to 147,745 lb., which shows a loss of more than 53 per cent from the total arrivals in January, 1924. Allowing for variations in consuming requirements, it is evident that the domestic industry is strongly entrenched and production should take a broader and more regular course that was the case in the two preceding years.

The influence of import tariffs is expected to be extended in the near future. It is practically certain that a lower duty on linseed oil will be proclaimed within a few days. The effect of this change will vary in degree according to the extent to which the present duty is lowered, but even a slight change will increase competition from foreign crushers and bring about a downward revision of prices. Chlorates, on the other hand, are expected to be favored with an increase in duty which will work to the advantage of domestic producers. More distant is the possibility of tariff action on caustic potash. This has not been included in the list of chemicals into which tariff investigations have been made but the practical monopoly which the foreign-made product now enjoys together with the control of supplies and the fixation of prices abroad, has developed rumors that greater protection would be asked for domestic producers. Interest in this matter was heightened by recent reports from markets in Northern Europe which stated that lower prices for caustic potash were prevailing in those markets because of dumping of stocks from Germany.

Synthetic Methanol A Factor

One of the most important recent developments in the market for chemicals consists in the presence of synthetic methanol as a commercial product. Offerings of this material from foreign markets have attracted attention for some time but importations have now assumed proportions which prove it has established a consuming outlet. As evidence that trial orders have proved satisfactory, it may be mentioned that large domestic consumers have placed long term contracts at prices said to be about 25 per cent below those which have been prevailing for domestic methanol. Some of these contracts are reported to extend over very long periods and to carry provisions which protect both buyer and seller against future changes in import duty. In some cases, foreign sellers are reported to have quoted a fixed price for 3 years ahead with the duty protection clause. These offers are said to be made in order to open up a regular outlet for this product and as a guarantee to the buyer, against an advance in price, when and if, this chemical should become supreme in the market. That domestic producers of methanol are alarmed because of the inroads made by the synthetic material is shown by the application, just made, for an increase in import duty for this material.



Current Prices in the New York Market

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. producing points, the quotations are given on that basis and are so designated. Prices for the corresponding period last month and last year are included for comparative purposes.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums ....lb.	$0.10 -$0.11	$0.10 -$0.11	$0.18½-$0.19½
Acid, acetic, 28%, bbl ....cwt.	3.12 - 3.37	3.12 - 3.37	.38 - 3.63
Boric, bbl ....lb.	.10½- .10¾	.10½- .10¾	.10 -......
Citric, kegs ....lb.	.46 - .47	.46 - .47	.46½- .48
Lactic, 44%, tech., light, bbl.lb.	.13½- .14	.13½- .14	.12½- .13
22% tech., light, bbl.......lb.	.06½- .07	.06½- .07	.06 - .06½
Muriatic, 18° tanks..........cwt.	.80 - .85	.80 - .85	.80 - .85
Nitric, 36° carboys..........lb.	.04 - .04½	.04 - .04½	.04 - .04½
Oxalic, crystals, bbl..........lb.	.10½- .11	.10½- .11	.10½- .11
Sulphuric, 60°, tanks..........ton	8.50 - 9.50	8.50 - 9.50	9.00 -10.00
Tartaric, powd., bbl..........lb.	.27½- .29	.27½- .29	.27- .30
Alcohol ethyl, 190 p'f. U.S.P. bbl..........gal.	4.90 -......	4.89 -......	4.81 -......
Alcohol, denatured, 190 proof No. 1 special dr..........gal.	.60½-......	.55 -......	.45½-......
No. 5, 188 proof, dr..........gal.	.59½-......	.54 -......	.44½-......
Alum, ammonia, lump, bbl..lb.	.03½- .04	.03½- .04	.03½- .04
Potash, lump, bbl..........lb.	.03¼- .03½	.03¼- .03½	.03¼- .03½
Aluminum sulphate, com., bags..........cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.50
Aqua ammonia, 26°, drums..lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Ammonia, anhydrous, cyl...lb.	.30 - .32	.30 - .32	.28 - .30
Ammonium carbonate, powd. tech., casks..........lb.	.12 - .12½	.12 - .12½	.12 - .13
Ammonium nitrate, tech., casks..........lb.	....	....	.09 - .10
Ammonium sulphate, wks.....cwt.	2.75 - 2.85	2.75 - 2.85	2.85 -......
Amylacetate tech., drums....gal.	3.25 - 3.50	3.25 - 3.50	3.50 - 4.00
Arsenic, white, powd., bbl...lb.	.05½- .05¾	.05½- .05¾	.12 - .12½
Arsenic, red, powd., kegs....lb.	.13½- .14	.13½- .14	.15 - .15½
Barium carbonate, bbl..........ton	52.00-58.00	53.00-54.00	63.00-68.00
Barium chloride, bbl..........ton	66.00-70.00	66.00-70.00	82.00-88.00
Barium, nitrate, casks..........lb.	.07½- .08	.07½- .08	.08- .08½
Bleaching powder, f.o.b. wks., drums..........cwt.	2.00 - 2.10	2.00 - 2.10	1.75 -......
Borax, bbl..........lb.	.05 - .05½	.05 - .05½	.05½- .05½
Calcium acetate, bags..........cwt.	3.00 - 3.05	3.00 - 3.05	4.00 - 4.05
Calcium arsenate, dr..........lb.	.07½- .08	.08 - .08½	.11 - .11½
Calcium carbide drums..........lb.	.05 - .05½	.05 - .05½	.05 - .05½
Calcium chloride, fused, dr. wks..........ton	21.00 -......	21.00 -......	21.00 -......
Carbon bisulphide, drums...lb.	.05½- .06½	.06 - .06½	.06 - .06½
Carbon tetrachloride drums..lb.	.07 - .07½	.07 - .07½	.07½- .08
Chlorine, liquid, tanks, wks..lb.	.04½-......	.04½-......	.04 - .04½
Copperas, bulk, f.o.b. wks....ton	15.00 -16.00	16.00- 18.00	16.00 -18.00
Copper carbonate, bbl..........lb.	.17½- .18	.17½- .17½	.18 - .18½
Copper sulphate, bbl..........cwt.	4.65 - 4.85	4.65 - 4.85	4.60 - 4.85
Cream of tartar, bbl..........lb.	.21 - .21½	.21 - .21½	.22½- .23
Epsom salt, dom., tech., bbl..cwt.	1.75 - 2.00	1.75 - 2.00	1.75 - 2.00
Epsom salt, imp., tech., bags.cwt.	1.25 - 1.30	1.25 - 1.30	1.10 - 1.15
Ethyl acetate, 85% drums...gal.	.95 - .97	.92 - .95	1.10 -......
Formaldehyde, 40%, bbl.....lb.	.09 - .09½	.09 - .09½	.11 - .11½
Fusel oil, crude, drums..........gal.	2.70 - 3.00	2.70 - 3.00	2.50 - 2.75
Glaubers salt, bags..........cwt.	.85 - 1.40	.85 - 1.40	.95 - 1.40
Glycerine, c.p., drums, extra..lb.	.19 - .20	.19 - .19½	.16½- .17
Lead:			
White, basic carbonate, dry, casks..........lb.	.11½-......	.11½-......	.10½-......
White, basic sulphate, casks..........lb.	.10¾-	.11 -......	.09½-......
Lead acetate, white crys., bbl.lb.	.15½- .16	.15½-......	.15 -......
Lead arsenate, powd., bbl...lb.	.15½- .16	.15½- .16	.18 -......
Lithopone, bags..........lb.	.06 - .06½	.06 - .06½	.06½- .06½
Magnesium carb., tech., bags.lb.	.06½- .07	.07 - .08	.08½- .08½
Methanol, 95%, dr..........gal.	.70 - .72	.70 - .72	.93 -......
Methanol, 97%, dr..........gal.	.72 - .74	.72 - .74	.95 -......
Nickel salt, double, bbl..........lb.	.09 - .10	.09 - .10	.09½- .10
Nickel salts, single, bbl..........lb.	.10 - .11	.10 - .11	.10½- .11
Phosphorus, red, cases..........lb.	.68 - 1.00	.68 - 1.00	.70 - .75
Phosphorus, yellow, cases.....lb.	.32 - .35	.32 - .35	.35 - .40
Potassium bichromate, casks.lb.	.08½- .08¾	.08½- .08¾	.09½- .09¾
Potassium carbonate, 80-85%, calcined, casks..........lb.	.06 - .06½	.06 - .06½	.06½- .06¾
Potassium chlorate, powd....lb.	.07½- .08	.07 - .08	.07½- .08½
Potassium hydroxide (caustic potash) drums..........lb.	.07½- .07¾	.07½- .07¾	.06½- .06¾
Potassium muriate, 80% bags..........ton	34.55 -......	34.55 -......	34.55 -......
Potassium nitrate, bbl..........lb.	.06 - .07½	.06 - .07½	.07½- .09
Potassium permanganate, drums..........lb.	.14 - .14½	.14 - .14½	.14 - .14½
Potassium prussiate, yellow, casks..........lb.	.18 - .18½	.18 - .18½	.20 - .20½
Salammoniac, white, casks...lb.	.05½- .07	.05½- .07	.06½- .08
Salsoda, bbl..........cwt.	1.20 - 1.40	1.20 - 1.40	1.20 - 1.40
Soda ash, light, 58% bags, contract..........cwt.	1.25 -......	1.25 -......	1.25 -......
Soda, caustic, 76%, solid, drums, contract..........cwt.	3.10 -......	3.10 -......	3.10 -......
Sodium acetate, works, bbl..lb.	.05½- .06	.05½- .05½	.05 - .05½
Sodium bichromate, casks...lb.	.06½- .06¾	.06½- .06¾	.07½- .07¾
Sodium chlorate, kegs..........lb.	.06½- .07	.06½- .06¾	.06½- .07
Sodium cyanide, cases, dom..lb.	.18 - .22	.18 - .22	.19 - .22
Sodium fluoride, bbl..........lb.	.09 - .09½	.09 - .09½	.09 - .10½
Sodium nitrate, bags..........cwt.	2.65 - 2.67	2.65 - 2.67	2.50 -......
Sodium nitrate, casks..........lb.	.09 - .09½	.09 - .09½	.08½- .08½
Sodium phosphate, dibasic, bbl..........lb.	.03½- .03¾	.03½- .03¾	.03½- .03¾
Sodium prussiate, yel. drums.lb.	.10 - .10½	.10¼- .10½	.11¼- .12
Sodium silicate (30°, drums).cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sodium sulphide, fused, 60-62% drums..........lb.	.02¾- .03¼	.02¾- .03¼	.03½— .03½
Sodium sulphite, crys., bbl...lb.	.03¼- .03½	.03¼- .03½	.03½- .03¾
Sulphur, crude at mine, bulk.ton	14.00 -16.00	14.00 -16.00	16.00 -18.00
Sulphur, flour, bag..........cwt.	2.35 - 3.00	2.35 - 3.00	2.25 - 2.35
Tin bichloride, bbl..........lb.	.15¾-......	.16 -......	.15¾- .16
Tin oxide, bbl..........lb.	.61 -......	.61 -......	.60 -......
Tin crystals, bbl..........lb.	.39 -......	.39½- .40	.39 - .39½
Zinc chloride, gran,, bbl.....lb.	.06½- .07½	.06½- .07½	.05 - .05½
Zinc oxide, lead free, bag....lb.	.07¾-......	.07¾-......	.07¾-......
5% lead sulphate, bags....lb.	.06¾-......	.06¾-......	.07¼-......
Zinc sulphate, bbl..........cwt.	3.00 - 3.50	3.00 - 3.50	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl..........lb.	$0.17 -$0.17¼	$0.17 -$0.17¼	$0.15 -......
Chinawood oil, bbl..........lb.	.14 - .14¼	.14¼- .14½	.17¼- .18
Coconut oil, Ceylon, tanks, N. Y..........lb.	.10½-......	.09¾- .09¾	.08¾-......
Corn oil, Crude, tanks, (f.o.b. mill)..........lb.	0 .10¼-......	.09¾- .10	.09 -......
Cottonseed oil, crude (f.o.b. mill), tanks..........lb.	.10 -......	.08¾- .09	.08 -......
Linseed oil, raw, car lots, bbl.gal.	1.14 -......	1.15 -......	.86 -......
Palm, Lagos, casks..........lb.	.09¾-......	.09½-......	.07¾-......
Niger, casks..........lb.	.09 -......	.08½-......	.07 -......
Peanut oil, crude, tanks (mill) lb.	.11¼-......	.11 - .11¼	.12½-......
Rapeseed oil, refined, bbl....gal.	.94 - .95	.90 - .91	.90 -......
Sesame, bbl..........lb.	.15 - .15¼	.14½- .14¾	.11½-......
Soya bean tank (f.o.b. Coast) lb.	.11½-......	.11 - .11¾	.10¼- .10½
Sulphur (olive foots), bbl....lb	.09½- .09¾	.09½- .09¾	.09¾- .10
Cod, Newfoundland, bbl.....gal.	.62 - .63	.62 - .63	.65 - .67
Menhaden, light pressed, bbl..gal.	.72 - .75	.72 - .75	.62 -......
Crude, tanks(f.o.b. factory)gal.	.55 -......	.55 -......	.47½-......
Grease, yellow, loose..........lb.	.09 - .09½	.08½- .08½	.06¾- .07
Oleo Stearine..........lb.	.12 - .12¼	.10¼-......	.09¾-......
Red oil, distilled, d.p. bbl....lb.	.11½- .11¾	.09 - .09½	.07¾-......
Tallow, extra, loose..........lb.	.09½- .09¾	.09 - .09½	.07¾-......

Coal-Tar Products

	Current Price	Last Month	Last Year
Aniline oil, drums, extra.....lb.	$0.16 -$0.16½	$0.16 -$0.16½	$0.16 -$0.16½
Aniline salts, bbl..........lb.	.20 - .22	.20 - .22	.22½- .23
Anthracene, 80%, drums....lb.	.65 - .70	.65 - .70	.75 - .80
Benzol, 90%, tanks, works....gal.	.22 -......	.21 -......	.23 -......
Beta-naphthol, tech., drums.lb.	.24 - .25	.24 - .25	.25 -......
Cresylic acid, 97%, drums, works..........gal.	.59 - .62	.59 - .62	.70 - .73
Naphthalene, flake, bbl......lb.	.05 - .05½	.05 - .05½	.06 - .06½
Phenol, U.S.P., drums......lb.	.23 - .25	.23 - .25	.28 - .34
Picric acid, bbl..........lb.	.25 - .26	.25 - .26	.20 - .22
Resorcinal, tech., kegs......lb.	1.30 - 1.40	1.30 - 1.40	1.40 - 1.50
Salicylic acid, tech., bbl.....lb.	.33 - .34	.33 - .34	.32 - .33
Solvent naphtha, w.w., tanks gal.	.25 -......	.25 -......	.23 -......
Toluene, tanks, works..........gal.	.26 -......	.26 -......	.30 -......
Xylene, com., tanks..........gal.	.25 - .26	.25 - .26	.28 -......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl....ton	$17.00-$17.50	$17.00-$17.50	$16.00-$17.00
Casein, tech., bbl..........lb.	.13 - .14	.13 - .14	.11½- .12
China clay, powd., f.o.b. Ga.ton	12.00- 15.00	12.00 -15.00	14.00 -20.00
Imported, pwd..........ton	45.00 -50.00	45.00 -50.00	45.00 -50.00
Dry colors:			
Carbon gas, black (f.o.b. works)..........lb.	.06½- .08½	.06½- .08½	.07½- .09
Lamp black, bbl..........lb.	.12 - .40	.12 - .40	.12 - .40
Prussian blue, bbl..........lb.	.35 - .37	.35 - .37	.40 - .43
Ultramarine blue, bbl.....lb.	.08 - .35	.08 - .35	.08 - .35
Sienna, Italian, bbl..........lb.	.04 - .12	.04 - .12	.06 - .14
Umber, Turkey, bbl..........lb.	.04 - .04¼	.04 - .04¼	.04 - .04¼
Chrome green, bbl..........lb.	.29 - .31	.29 - .31	.28 - .30
Carmine red, tins..........lb.	4.25 - 4.50	4.25 - 4.50	4.50 - 4.70
Para toner..........lb.	.90 - .95	.90 - .95	1.00 - 1.10
Vermilion, English, bbl....lb.	1.40 - 1.45	1.40 - 1.45	1.15 - 1.20
Chrome yellow, C. P., bbl.lb.	.19½- .20½	.19½- .20½	.16¾- .17¾
Ocher, French, casks..........lb.	.02 - .03	.02 - .03	.02¼- .03
Feldspar, No. 1 (f.o.b. N. C.)ton	6.50 - 7.25	6.50 - 7.25	6.50 - 7.00
Graphite, Ceylon, lump, bbl.lb.	.07 - .07¼	.07 - .07¼	.05¼- .06
Gum copal, Congo, bags......lb.	.08 - .09½	.08½ - .10	.10 - .15
East Indian, bags..........lb.	.14 - .15	.14 - .15	.20 - .21
Manila, bags..........lb.	.14 - .16	.14 - .16	.19 - .20
Damar, Batavia, cases....lb.	.28 - .28¼	.28 - .28¼	.23½- .24
Kauri, No. 1 cases..........lb.	.60 - .65	.60 - .65	.64 - .66
Kieselguhr (f.o.b. N. Y.)....ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc..........ton	35.00 -42.00	35.00 -42.00	35.00 -40.00
Pumice stone, lump, bbl.....lb.	.06 - .08	.06 - .08	.05 - .05½
Imported, casks..........lb.	.03 - .40	.03 - .40	.03 - .35
Pyrites, Span., fines, cif.....unit	.11½- .12	.11½- .12	.10 - .10½
Domestic, fines (f.o.b. Ga.) unit	.12 -......	.12 -......	.10½- .11
Shellac, orange, fine, bags....lb.	.66 - .68	.64 - .65	.59 -......
Bleached, bonedry, bags...lb.	.67 - .69	.71 - .73	.66 - .67
T. N., bags..........lb.	.58 - .59	.62 - .63	.56 - .57
Soapstone (f.o.b. Vt.), bags..ton	7.00 - 7.50	7.00 - 7.50	7.50 - 8.00
Talc, 200 mesh (f.o.b. Vt.)...ton	10.50 -......	10.50 -......	10.00 -......
200 mesh (f.o.b. Ga)..........ton	7.50 -10.00	7.50 -10.00	8.00 -12.00
325 mesh (f.o.b. N. Y.)....ton	14.75 -......	14.75 -......	14.75 -......
Wax, Bayberry, bbl..........lb.	.21 - .22	.21 - .22	.25 - .26
Beeswax, ref., light..........lb.	.45 - .49	.50 - .52	.32 - .34
Candelilla, bags..........lb.	.30 - .31	.30 - .31	.23 - .23½
Carnauba, No. 1, bags....lb.	.35 - .37	.36 - .37	.37 - .38
Paraffine, crude 105-110 m.p..........lb.	.06½- .06¾	.06½- .06¾	.05 -......

Current Industrial Developments

New Construction and Machinery Requirements

Outstanding Opportunities

Asphalt, varnish, etc.	Los Angeles, Cal.
Candy	Philadelphia, Pa.
Celluloid	Athol, Mass.
Cement	Painsville, O.
Chemica	St. Louis, Mo.
Fertilizer	Tulsa, Okla.
Gas	Victoria, Tex.
Gypsum	Seattle, Wash.
Lead	Cleveland, Tex.
Linoleum	Hutchinson's Mills.
Oil	Cairo, Ill.
Paper	Baltimore, O.
Paints	Montreal, Que.
Refinery	St. Elmo, Tenn.
Smelting	El Paso, Tex.
Sugar	Chinook, Mont.
Syrup	Lufkin, Tex.
Waxed paper	Tacoma, Wash.

New England

Conn., Hartford—Trinity College Corp. plans the construction of a laboratory on Zion St., Trowbridge & Livingston, 527 Fifth Ave., New York, are engineers.

Conn., Stamford—Richards & Company, Ludlow St., awarded contract for the construction of a 80x340 ft. chemical factory, on Ludlow St., to J. W. Ferguson Co., Patterson, N. J. Estimated cost $40,000.

Me., West Paris—Maine Milling & Mining Co., Portland, W. L. Adams, 211 Ocean Ave., et al., plan the construction of a feldspar grinding plant with 40 to 50 ton capacity per day, here. Electric power to be used.

Mass., Athol—Wilcox Novelty Co., 256 Main St., plans the construction of a 3 story, 40x200 ft. factory unit for the manufacture of celluloid novelties, on Main St. Estimated cost $125,000. Architect not selected.

Mass., Boston—Mayfair Mfg. Co., 31 Milk St., is in the market for complete electro plating outfit, with generator and tank, capacity 100 gallons.

Mass., Charlestown (Boston P. O.)—S. M. Howard Co., 503 Medford St., stove manufacturer, plans to replace machinery for lacquer room, destroyed by fire. Estimated cost $12,000.

Mass., North Adams—North Adams Gas & Electric Co. B. K. Cook, Mgr., is receiving bids for the construction of a gas plant. W. M. Russel, 77 Franklin St., Boston, is architect.

Mass., Norwood—Bird & Son, East Walpole, paper manufacturers, awarded contract for additions to printing oven, and finish buildings for plant here to Central Engineering and Construction Co., Slater Bldg., Providence, R. I. Estimated cost $185,000.

Mass., Somerville—E. F. Kemp, Skelton Ave., is having plans prepared for the construction of a 2- and 3-story, 35 x 65 ft. addition to candy factory on Skelton Ave. Estimated cost $45,000. W. Sidebottom, 101 Tremont St., Boston, is architect.

Middle Atlantic

Md., Baltimore—Maryland Glass Corporation, Mt. Winas, awarded contract for the construction of a 2-story, 30 x 83 ft. glass bottle factory, at Linden Ave. and Ontario Sts. Estimated cost $60,000. Glass blowers and tanks will be required.

N. J., Hutchinsons Mills (Trenton P. O.)—W. & J. Sloane, Fifth Ave., New York City, awarded the masonry contract for a group of factory buildings for linoleum plant on Bear Swamp Rd. to Karno-Smith Co., Broad St., $500,000. Lockwood Greene and Co. 1 Pershing Sq., New York City, are architects.

N. J., Jersey City—Natural Product's Chemical Co. recently incorporated in New Jersey with $100,000 capital, a subsidiary of the Natural Products Refining Co., 902-910 Garfield Ave., plans the construction of a plant for the manufacture of chemicals. H. A. Goman, is president.

N. J., Trenton—Freeman Electric Co., 10 Prince St., plans the construction of a 2-story electric porcelain factory. Estimated cost $40,000. J. O. Hunt, 219 East Hanover St., is engineer.

This page is of value not only as a machinery market but also as an index of the general activity and growth of the industries served by Chem. & Met. The reports are gathered by our regular correspondents who are instructed to verify every detail. Requirements for new machinery will be published here free of charge.

N. Y., Buffalo—Niagara Falls Smelting & Refining Corporation, 1070 Niagara St., is in the market for briquetting machines for making metal bricks, 12 x 5 x 5 or 11 x 4 x 4.

N. Y., Buffalo — Plastergon Wall Board Co., 196 Philadelphia Ave., W. J. Saville, Pres., has had plans prepared for the construction of two, 150 x 200 ft. buildings for plant. Estimated cost $250,000.

N. Y., New York—F. G. Shattuck Co., 60 West 23 St., is having plans prepared for the construction of a 12 story, 100x200 ft. candy factory at 43 West 22nd St. Estimated cost $500,000. R. G. Corey, 30 Church St., is engineer.

Pa., Philadelphia—Brooks Bros. Co., 4841 Lancaster Ave., awarded contract for the construction of a 3 story, 62x108 ft. candy factory, to Robbins Construction, 1137 North Front St. Estimated cost $75,000. A. W. Barnes, Ferry Bldg., is architect.

Pa., Philadelphia—Willard Candy and Chocolate Co., Jasper and Willard Sts., plans the construction of a 2-story, 66 x 150 ft. factory at Tioga and White Sts. Estimated cost $75,000. J. Linsohm, Broad and Girard Sts., is architect.

Pa., Philadelphia—C. E. Wunder, 1520 Locust Pl., Archt., will soon award contract for the construction of a 3 story, 74 x 146 ft. candy factory, at 5051-61 Lancaster Ave. for Minter Bros., 5051 Lancaster Ave.

South

Ala., Birmingham—Alabama Clay Products Co., is in the market for 300 to 500 steel or galvanized iron pallets, 11 or 12 by 34 or 36 in. long.

Fla., Gainsville—Voyle & Co. plan the construction of a plant for the manufacture of duntile.

Ga., Atlanta—Logan Long Co., Franklin, O., awarded contract for the construction of a plant for the manufacture of asphalt shingles and roofings, here. Estimated cost $300,000.

La., Shreveport—Southwestern Gas & Electric Co., is having preliminary plans prepared for the construction of a 150 x 270 ft. building for gas plant No. 2 at T. S. & N. R.R. and Pierre St. E. F. Neild, 1206 Merchants Bldg., is architect.

N. C., Cumnock—Carolina Fireproofing Co., Sanford, I. Hechenbleikner, Pres., Heritage Rd., Charlotte, plans the construction of the first unit of plant for the manufacture of hollow tile and fireproof material, capacity 5 carloads per day, here. Gas for burning tile will be manufactured from coal produced at the Cumnock mines.

Tenn., Cleveland—G. Blow, Knoxville, is considering taking option on 1,000 acres, including the Hardwick Holdings, to develop lead deposits.

Tenn., St. Elmo—Fowler Lewis Oil Refining Co., 5415 Beulah Ave., J. V. Lewis, Pres., plans the construction of a plant for reclaiming lubricating oils, on 2 acre site. Equipment will include tanks, drums, steam pumps, 100 hp. boiler, stills, filters, piping, valves, etc. F. E. Fowler, 5414 Beulah Ave., is engineer.

Tenn., Memphis—Nurre Glass Manufacturing Co., Bloomington, Ind., awarded contracts for the construction of a plant here. Estimated cost $75,000. E. L. Harrison, Fidelity Bank Bldg., is architect.

Middle West

Ill., Cairo—Cairo Oil Mill Co., G. M. Greenwood, Pres., is having preliminary plans prepared for the construction of an oil mill at Sycamore St. and I. C. tracks. Estimated cost $150,000. E. M. Murray, 86 North 3rd St., Memphis, is engineer.

Ill., Chicago—Bird Archer Co., 33 Rector St., New York City, awarded contract for a 2-story, 18,000 sq.ft. factory for the manufacture of boiler compounds here, to The Austin Co., 2088 La Salle St., Chicago. Estimated cost $50,000. F. B. Bird is president.

Ind., Evansville—Berryhull Malleable Iron Co. has work underway on the construction of a 120x240 ft. foundry for the manufacture of malleable iron castings. Estimated cost $50,000. Equipment for plant will be required, including casting and cleaning machinery, tumbling barrels, sand blast barrels, etc. J. H. Berryhull is president.

Mich., Iron Mountain—Iron Mountain Gas Co., W. L. Tibbs, Pres., 214 West Water St., Milwaukee, has purchased the gas plant of the Citizens Gas Co. and plans the construction of a new 2 story gas plant, mains, etc. Machinery and equipment will be required. Engineer not selected.

O., Baltimore — Fanfield Paper Co. awarded contract for the construction of a 50 x 200 ft. factory, and 50 x 50 ft. powerhouse, to H. K. Ferguson Co. 4900 Euclid Ave., Cleveland. Estimated cost $100,000. Private plans.

O., Osborn—Washash Portland Cement Co., Ford Bldg., Detroit, Mich., has work under way on a new cement plant here. Spencer Construction Co., Garrett Bldg., Baltimore, Md., has contracts covering all concrete work, including pack and bag house, slurry tanks, etc.

O., Painsville—Diamond Alkali Co., First National Bank Bldg., Pittsburgh, Pa., has work under way on new cement plant here. The Spencer Construction Co., Garrett Bldg., Baltimore, Md., has contract covering all concrete work including a pack and bag house, slurry tank, etc.

Wis., Green Bay—W. Larsen Canning Co., North Broadway, awarded contract for remodeling 100 x 120 ft. cannery to L. Hansen & Sons, 527 South Ashland St. Estimated cost $40,000. Conveying and canning machinery will be required.

Wis., Manitowoc—Wisconsin Fuel and Light Co. plans to enlarge its gas plant, here and build a gas holder and approximately 7 miles of mains, in Two Rivers. Private plans.

Wis., Milwaukee — Harnischfeger Corporation, 871 Robinson Ave., A. G. Hendricks, V.-Pres., is taking bids for the construction of a 62 x 90-ft. core room, for electric steel foundry, on Robinson Ave. Estimated cost $25,000. Core making equipment, including ovens will be required. O. T. Willms is plant layout engineer.

West of Mississippi

Ark., Hot Springs—Mexican Canning Association, W. S. Winson, Pres., 330 Mt. Ida St., plans the construction of a plant here, for canning fruits, vegetables, fish; seed oil, extracts, etc. Equipment will be required.

Kan., Hutchinson—Lloyd Lewis plans the construction of a 2-story, 66 x 165 ft. dry cleaning plant. Estimated cost $40,000. Architect not selected.

Kan., Kansas City—Air Reduction Sales Co., Ft. of 56th St., Brooklyn, N. Y., has work under way on the construction of a plant for the manufacture of acetylene welding appliances and commercial gases for welding here, including a 41 x 50 ft. gas house, 20 x 40 ft. oxygen storage, 20 x 40 ft. carbide storage house, 18 x 30 ft. boiler room, 13 x 25 ft. generating house, and 18 x 26 ft. office. Estimated cost $60,000.

Mo., Joplin—Burch Lead & Zinc Co., having preliminary plans prepared for the construction of a new mill building and equipment for lead and zinc mine. Estimated cost $100,000. **Private plans.**

Mo., St. Louis—Louis Maull & Co., Eighth and Spruce Sts., will be in the market about June or July, for equipment for proposed new canning plant and cucumber salting station to be constructed at Monett.

Mo., St. Louis—Monsanto Chemical Works, 1800 South Second St., plans alterations and improvements to chemical plant, on Second St. Work will be done by day labor. Private plans.

Mo., St. Louis—Laclede Gas Light Co., 11th and Olive Sts., awarded contract for the construction of a 31x39 ft. gas booster gas station, on Polk Ave., to Kopper Co., Pittsburgh, Pa. Equipment for booster station will be required.

Mont., Chinook—Utah Idaho Sugar Co., Salt Lake City, Utah, awarded contract for the removal of its Yakima factory, to Chinook, Mont., to J. J. Burke & Co., Salt Lake City. B. R. Smoot is general superintendent.

Okla., Ponca—Marland Refining Co. will soon award contract for the construction of a 2 story, 60 x 114 ft. laboratory and office building. Estimated cost $100,000. Private plans.

Okla., Tulsa—G. W. Wade Hide and Fur Co., G. W. Wade, Mgr., 817 East Admiral, plans the construction of a fertilizer plant.

Tex., El Paso—El Paso Smelting Works will soon receive bids for the construction of a 40 x 80 x 200 ft. bag house to filter gases. Estimated cost $250,000. R. S. Moore, is company engineer.

Tex., Houston—Houston Car Wheel and Machine Co., White and Spring Sts., J. H. Dore, Pres., plans improvements to plant, including the construction of a 72 x 200 ft. building, installation of a 3 ton electric furnace, additional ovens, etc.

Tex., Lufkin—A. H. Hargis, Dallas, has leased the plant of the East Texas Syrup Co., and plans to manufacture compound syrups, etc.

Tex., Spears—Spears & Co. are having plans prepared for the construction of a 40 x 120 ft. addition to cotton oil mill. Estimated cost $75,000. Modern oil mill machinery, including Anderson propellers, continental linters, etc., will be required. Company engineer in charge.

Tex., Victoria—W. C. Sparks, Sinton, will submit to voters here, a proposition to construct natural gas plant, mains, etc., for supplying the city with natural gas. Estimated cost $60,000. L. C. Doney, Jr., Galveston, is engineer.

Tex., Waskom—W. M. Waterman, Pres. Waterman Lumber Co., plans the construction of a brick and tile plant, with capacity 100,000 brick and 5,000 roofing tile daily. Estimated cost $250,000.

Far West

Calif., Fresno—J. B. Inderrieden Co., Ventura and R Sts., awarded contract for the construction of a 2 story, 125 x 150 ft. packing plant, for dried fruits, on Ventura St. to J. McCollough, Fresno. Estimated cost $200,000.

Calif., Los Angeles—City has had plans prepared for the construction of a group of buildings for high school, on Lincoln St., including a 3 story science building, and a 2 story ceramics building, etc. Estimated cost $275,000. Webber, Stanton and Spaulding, Hibernian Bldg., are architects.

Calif., Los Angeles—Paraffine Co.'s Inc., 903 North Main St., manufacturers of asphalt products, oils and varnishes insulating material, etc., awarded contract for the construction of a 100 x 190 ft. and 180 x 360 ft. factory building on Vernon Ave. to MacDonald and Kahn, Spring Arcade Bldg.

Calif., Salinas—Coast Valleys Gas & Electric Co., 11 East Gabilan St., has appropriated funds in the 1925 budget for the construction of a gas generating plant annex, and gas holder with 200,000 cu.ft. capacity. Estimated cost $80,000.

Calif., San Francisco—Banner Refining Co., Third St. and Islais Creek, plans to rebuild oil storage plant, at Minnesota and 20th Sts., recently destroyed by fire. Estimated cost $250,000.

Calif., San Jose—California Paste Co., 259 South Market St., is having plans prepared for the construction of a 1-story factory, at Alameda and Auzerais Sts. Estimated cost $45,000. H. Bolwin, 411 Garland St., is architect.

Wash., Millwood—Inland Empire Paper Co. of Spokane (Millwood) J. J. Rosebush, pres., awarded contract for the design and construction and partial equipping of a 2 story, 145 x 255 ft. mill unit, to house paper machines, to the Austin Co., Dexter Horton Bldg., Seattle.

Wash., Priest Rapids—The Washington Irrigation and Development Co. (holding company for the General Electric Company of New York), application for license for Priest Rapids hydroelectric power project, on the Columbia River 200 miles east of Seattle, has been favorably acted upon by the Federal Power Commission. The General Electric Co., 120 Broadway, announced some time ago, that $55,000,000 will be expended in building a model industrial city, where various basic products will be manufactured by electro-chemical processes on 100,000 acres of land which will be irrigated by pumping water from the Columbia River with electric pumps.

Wash., Seattle—Pacific Coast Gypsum Co. has removed its plant from Tacoma, here, and plans the construction of a plant on 7-acre site on West Marginal Way. Estimated cost $300,000.

Wash., Tacoma—The Pacific Paper Products Co., plans the construction of a plant for manufacture of waxed paper on recently acquired site here.

Canada

B. C., New Westminster—Canada Creosoting Co., Toronto, Ont., plans the construction of a creosoting plant, with two 900,000 gal. tanks, here. Estimated cost $250,000. R. L. Bonham, Liverpool, is engineer in charge.

Ont., Collingwood—Bd. of Education is interested in prices on equipment for physics and chemistry laboratories for new collegiate buildings on Hurontario St. Contracts for construction of a building have been awarded to G. H. Thomas & Son, Dickson St., Galt, Ont. Estimated cost $150,000. J. Wilson, Collingwood, is architect.

Ont., Georgetown—Smith and Stone Clay Products Co., is in the market for equipment to replace fire loss, estimated at $40,000.

Ont., Windsor—Bayer Aspirin Co., plans the construction of a new plant and installation of additional machinery. Estimated cost $200,000.

Que., Chelsea—International Paper Co., 100 East 42nd St., New York City, A. R. Granstein, Pres., plans the construction of a pulp mill, 1,000 ton pulp per day capacity, on the Gatnieau River, here. Estimated cost $12,000,000.

Que., Hull—Canada Glass Products, Ltd. G. F. Pese, Pur. Agt., is in the market for complete machinery and equipment for new plant.

Que., Montreal—City, L. O. Pion, 21 St. Famille St., Pur. Agt., is in the market for general laboratory apparatus including equipment for making stress and strain tests, material analysis, etc.

Que., Montreal—International Paints Ltd. (Canada), 369 Craig St., East, is in the market for complete equipment for proposed paint and varnish factory on Collorn St.

Que., Montreal—Rockland Chemical Co., Ltd., c/o L. G. Bell, 120 St. James St., is in the market for complete equipment for manufacture of chemicals, dyes, etc.

Que., Quebec—Quebec Paper Co., Ltd., has changed name to Anglo-Canadian Pulp and Paper Co., 71 St. Peter St., plans are under way for the construction of a new paper mill. Estimated cost $10,000,000. G. Hardy, 309 Broadway, New York City, is engineer.

Sask., Saskatoon — University of Saskatchewan, W. C. Murray, Pres., plans to rebuild tractor laboratory, and engineering building of the university, to replace fire loss. Estimated cost $300,000. Owners are interested in prices on all equipment.

Dutch West Indies, Aruba Island—Lago Oil & Transport Co., Ltd., of Canada, 24 State St., New York City, plans the construction of a refinery here. Contract for dredging, dock construction and pipe line installation has been awarded to Salmons-Clement Co., Charleston, S. C.

Incorporations

Ky-In-Do Manufacturing Co., Dover, Del., liquid fertilizer, $200,000.

Click-O-Cleaner, Products Corp., Dover Del., $600,000. (Corporation Trust Co. of Delaware.)

Atlantic Oleomargarine Co., Wilmington, Del., $125,000. (Corporation Service Co.)

Martinsburgh Amiesite Plant, Wilmington, Del., $100,000. (Delaware Registration Trust Co.)

Butyl Corporation, Wilmington, Del., chemical solvents, $1,000,000.

Anglo-Guatemalan Petroleum Corp., Dover, Del., $7,500,000. E. L. Presby, M. R. Wynn, New York, J. P. Gilligan, Brooklyn. (Attorney, Arley B. Magee, Dover, Del.)

Pontiac Chemical Co., Dover, Del.; toilet articles, $150,000. M. A. DeRichelieu, H. P. Synder, Philadelphia. (Corporation Trust Co. of Delaware.)

Allen Company, Wilmington, Del., candy manufacturers, $200,000. (Corporation Trust Co. of America.)

Sterling Paint Products Corporation, Wilmington, Del., $100,000. (Attorney, Franklin L. Mettier, Wilmington.)

Internation Molasses Corp., Wilmington, Del., $40,000. (American Charter Co.)

Opal Products Co., Millville, N. J., manufacturers of glass, $25,000. L. F. Duke, F. L. Duke, Ridgewood; H. W. Mathews, Vineland.

Gelatine Paper, Buffalo New York, 250 shares, $100 each, 2,500 common stock, no par value, J. A. Naeher, M. E. Glenwinkel, W. L. Kirby. (Attorney, W. R. Heath, Buffalo.)

E. Vosburgh, Johnstown, N. Y., hides, 2,500 common, no par value, E. and R. D. Vosburgh, B. M. Buchanan. (N. F. Towner, Albany, N. Y.)

Binghamton Glass Co., Binghamton, $150,000. A. C. Yetter, F. L. Dennis. (Attorney H. A. Yetter, Binghamton.)

Sunshine Finding Co., White Plains, fuel products, 2,000 common, no par value, F. E. Smith, M. H. Rowe, E. I. McCarthy. (Attorneys, Strange & Taylor, White Plains.)

Rock Brock Corporation, Rochester, N. Y., cement products, 100 shares common stock, no par value. R. H. Field, H. A. Balwin, M. H. Green. (Attorneys, MacFarlane & Harris, Rochester.)

Soap Feeder Corporation, New York, N. Y., cleaning compounds, $100,000. L. and M. W. Halsey, J. Kohn. (Attorney, H. O. Coulson, 154 West 45th St., New York.)

Jaeger Chemical Co., New York, $100,000. H. Jaeger, A. M. Gerbaulet, F. F. Dumesnil. (Attorneys, Putney, Twombley, & Putney, 2 Rector St., New York.)

Liquid Leather Co., New York, N. Y., 60 common, no par value. A. L. Fowle, H. R. Denmead, M. A. Day. (Attorney, B. W. Wilson, 61 Broadway.)

Kase Quinby Rubber Co., New York, merchandise, $150,000. N. M. Kase, H. W. Quimby. (Attorney, W. K. Kimber, 149 Broadway.)

Textene Products, Bronx, New York, soaps, etc., $100,000. R. Lee, M. Katchor, J. F. O'Neil. (Attorney, F. K. Knorr, Albany.)

Edward Posen Co., New York, manufacture leather, $10,000. E. Kessler, Jr., J. H. Kleim, S. Bachrach. (Attorneys, Van Vorst, Seigel and Smith, 26 Broad St.)

Avlon Syrup Corp., Schenectady, N. Y., manufacture beverages. T. P. Avlon, A. J. Letarte, Sr., W. H. Vangaasbeek. (Attorneys, Blodgett & Smith, Schenectady.)

Wilmot Corporation, Rochester, N. Y., sensitized paper, $100,000. F. Wilmot, C. A. Brady, C. C. McCord. (Attorneys, Lynn Bros., Rochester.)

Roberts-Berce, Paper Co., Poughkeepsie, N. Y., $50,000. J. Roberts, J. Berce, F. I. Mackay. (Attorney, J. B. Ball, Poughkeepsie, N. Y.)

Silver King Rubber Co., Philadelphia, Pa., $300,000. (Corporate Guarantee and Trust Co.)

National Petroleum & Refining Co., Wichita Falls, Texas, increase capitol from $500,000 to $10,000,000.

Zeiley Processes Corp., Augusta, Me., refine manufacture, and deal in mineral oil, petroleum, greases, graphite, coal lignite, shale, etc., 200,000 shares, no par value. A. W. Britton, E. M. Thompson.

Emerald Gas Company of Dade County, Miami, Fla., 1,000 shares, no par value, R. H. Martin, Pres., R. D. Marsh, Secy.

Orangeland Paint and Supply Co., Bartow, Polk County, Fla., $25,000. J. E. Fortner, Pres., G. E. Walker, secy.

Florida Mineralized Humus Co., Tampa, Fla., $100,000. R. V. Thirion, Pres., J. Bemer, H. O. Roessling, Secy.

Wilson Candy Co., Orlando, Fla., $25,000. A. W. Hinson, Pres., H. M. Childress, Secy.

Box Paper Manufacturing Co., Inc., Holyoke, Mass., paper and paper products, $50,000. C. F. Mariarti, F. M. Moynahan, South Hadley; W. P. Welsh, Holyoke.

Empress Co., Cambridge, Mass., paints and pottery, $50,000. G. F. Gifford, C. A. Center, J. Meyer. (Attorney, E. B. Norton, Cambridge.)

Laclede Paint Manufacturing Co., St. Louis, Mo., manufacture and deal in paints, varnishes, etc., $5,000. G. K. McGunnegle, Webster Groves, H. C. McGunnegle, B. M. McDaniel, 3842 McDonald Ave., St. Louis.

Service Fruit Flavor Manufacturing Co., Paterson, N. J., manufacturers of extracts., $10,000. H. Zarrow, B. Sanders, Paterson; K. E. Tirpak, Passaic. (Attorney H. Loeb, Passaic.)